

COPY No. 55

BR. 257  
HANDBOOK  
FOR THE  
4 INCH Q.F. MARK XVI GUN  
ON THE  
H.A. TWIN MARK XIX AND SINGLE  
MARK XX MOUNTINGS

1941

55  
**RESTRICTED**

B.R. 257

## **HANDBOOK**

FOR THE

**4 INCH Q.F. MARK XVI\* GUN**

ON THE

**H.A. TWIN MARK XIX AND SINGLE  
MARK XX MOUNTINGS**

PZ 1572/5

1941

NAVAL ORDNANCE DEPARTMENT,  
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B.R. 257 Handbook for the 4-in. Q.F. Mark XVI\* Gun on the H.A. Twin Mark XIX and single Mark XX mountings, 1941, having been approved by My Lords Commissioners of the Admiralty, is hereby promulgated for information and guidance.

This edition supersedes O.U. 6361/1937, copies of which should be disposed of in accordance with the instructions in Form O.U. 2A—Catalogue of O.U. Books.

*By Command of Their Lordships.*

*H. V. Markham*

To Flag Officers and Commanding Officers of  
H.M. Ships and Vessels concerned.



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1.	P. 208.	7-7-43.	E. Woodman.
2.	P. 221.	12-7-43.	—
3.	P. 575.	18-11-43	E. Woodman
4.	P. 254.	12-11-43	E. Woodman
5.	P. 263.	12-5-44.	E. Woodman
6.	P. 410.	19-11-44.	E. Woodman.
7.	P. 418	23-8-44	W. H. H.
8.	P. 579	14-10-44	H. H. H.
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27.	P. 102/56	2-4-58	H.F.W.
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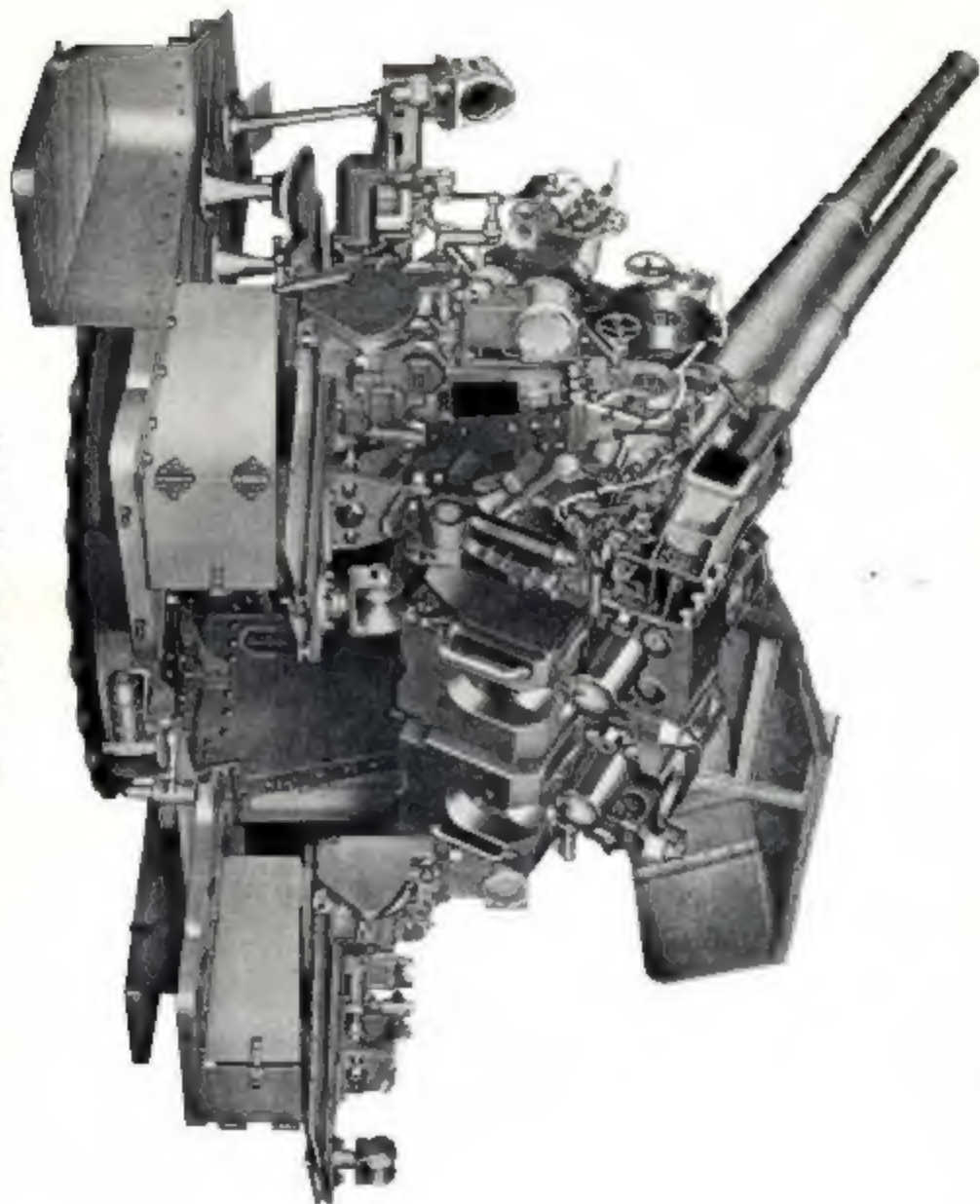
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(D.37693/68.—A.F.O. P.460/68.)



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THE 4.18, TWIN MARINE XIX MONITOR.



## CHAPTER I

## SECTION I—INTRODUCTION

**THE GUN**

The guns are of the quick-firing type, with breech blocks which move downward to open. This arrangement allows the guns to be placed closer together in the cradle, but a large and strong spring is required to close the breech in semi-automatic firing.

**THE MOUNTING**

2. The mounting follows generally the usual design of high angle centre pivot mountings. The guns are mounted in a common cradle and, therefore, elevate together, but each gun is provided with its own recoil and run-out arrangements. To reduce the trunnion height to a minimum, the trunnions are situated close to the breeches of the guns which necessitates the addition of heavy balance weights. The latter are keyed to the guns in front of the breech rings and are provided with pockets which can be filled with lead in order to obtain accurate balancing of the guns about the trunnions.

Mountings forming the H.A. armament of a ship are placed on a 6-in. packing ring. Those forming the primary armament of a small ship where they may be used for either L.A. or H.A. firing are carried on a  $\frac{1}{2}$ -in. packing ring to facilitate loading at low angles of elevation.

**ELEVATING AND TRAINING**

3. Elevating and training positions are fitted on the left and right-hand sides of the mounting respectively.

**SAFETY FIRING GEAR**

4. Safety firing gear consists of a series of levers operated by means of a cam rail secured to the deck and ensures that the firing circuit is broken when the mounting is trained into a danger zone.

*NOTE: R.P. series mounting and some plain mountings are fitted with safety firing gear and are in front of safety firing gear which breaks the firing circuit independently of the direction of fire.*

**THE SHIELD**

5. The shield is made of protective plating  $\frac{1}{2}$ -in. thick and is made in halves, bolted together at the front beneath the chase of the guns and connected at the top rear edge by a girder.

P.71/60

**THE SIGHTS**

6. The sights are designed for use in L.A. firing only and no sighting arrangements for controlled H.A. fire are provided. Forward area barrage sights are fitted at layers' and trainers' positions and can be used for local barrage fire up to 70 deg. elevation.

**FUZE SETTING ARRANGEMENTS**

7. Mechanical fuze setting machines or fuze receivers are carried on brackets at the rear edge of the gunlayers' and trainers' platforms.

In W ships only, fuze setting machines of the Mark II series have been removed but the fuze setting trays are retained. These have been modified to provide a 'rest' position for the ammunition. The setting of starshell fuses is by means of a hand fuze setting key, Mark 2, which is kept in a watertight box secured to a base plate fitted on each tray. The guns are illuminated is provided adjacent to the box.

- |  |   |
|--|---|
| (a) Control position .. .. .                       | For all mountings.  |
| (b) Locally by means of gun layers trigger .. .. . | Plain and R.P. series.  |
| (c) Joystick firing switch .. .. .                 | For R.P.51 and R.P.52 mountings only.   |
| (d) Breech workers firing push .. .. .             | For both plain and R.P. series mountings fitted with safety firing switch gear. |

In the event of a missfire or failure of the electric circuit, the guns can be fired in percussion by means of palm operated firing levers.

elevating and training gear vary, but in general the description of the gear is applicable to the single Mark XX. (G. 87778/43.—A.F.O. P.71/50.)

**REMARKS**

10. Identification of a part of the gun or mounting will be facilitated if, in correspondence, the names used in this handbook are employed.

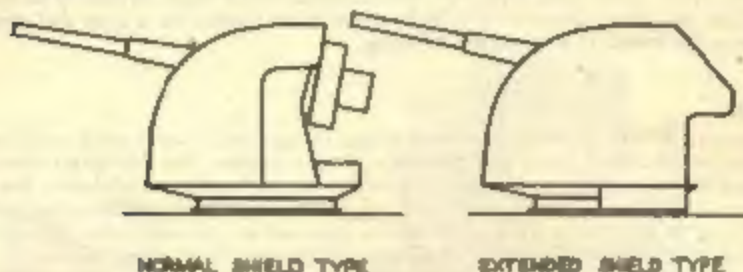


# PARTICULARS OF GUNS AND MOUNTINGS. (Plates 1, 2, 3, 4, 5.)

## Types

11. 4 in. H.A. Twin Mark XIX mountings are of THREE types, viz. :—

- (i) The normal.
- (ii) Those fitted with extended shields for use in conjunction with structural blast screens.
- (iii) Those fitted with hand fuse setting positions and no fuse setting machines.



12. The different types are designated by the addition of "•" for type (ii) and "†" for type (iii) vide A.F.O. 625/38.

Types (i) and (ii) may mount Mark I, Mark II or Mark V fuse setting machines. The Mark V machine is fitted 12 in. forward of the Marks I and II machines on account of the increased length of the shell tray.

Unless otherwise stated, the following details are applicable generally to both the Mark XIX and Mark XX mountings.

## 13. Weights

	Mark XIX	Mark XIX•	Mark XIX†	Mark XX
(a) (i) Cradle and fittings .. .. .	Tons 2.05	Tons 2.05	Tons 2.05	Tons 1.05
(ii) Sight .. .. .	.. .. . 20	.. .. . 20	.. .. . 20	.. .. . 25
(iii) Carriage, shield and platform .. .. .	5.20	6.10	5.20	4.40
(iv) Training base complete with rollers and rack .. .. .	1.30	1.30	1.30	1.30
(v) Marks I or II fuse setting machines (total per mounting) .. .. .	.. .. . 30	.. .. . 30	.. .. .	.. .. . 15
(vi) Mark V fuse setting machines (total per mounting) .. .. .	.. .. . 60	.. .. . 60	.. .. .	.. .. .
(vii) Hand fuse setting turntables, etc. .. .. .	.. .. .	.. .. .	.. .. . 15	.. .. .
(viii) Guns (total per mounting including breech mechanism) .. .. .	4.00	4.00	4.00	2.00
(ix) Balance rings (total per mounting) .. .. .	1.25	1.25	1.25	.. .. . 70
(b) (i) Elevating mass .. .. .	7.60	7.60	7.60	3.75
(ii) Training mass (mountings fitted with Marks I or II fuse setting machines or hand fuse setting turntables, etc.) .. .. .	13.65	14.50	13.40	8.55
(iii) Training mass (mountings fitted with Mark V fuse setting machines) .. .. .	13.65	14.85	.. .. .	.. .. .
(iv) Total recoiling mass .. .. .	5.80	5.80	5.80	2.90
(c) (i) Total weight (mountings fitted with Marks I or II fuse setting machines or hand fuse setting turntables, etc.) .. .. .	14.30	15.20	11.15	9.85
(ii) Total weight (mountings fitted with Mark V fuse setting machines) .. .. .	14.60	15.50	.. .. .	.. .. .

## 14. Ballistics

### (a) Full Charge

- (i) Initial muzzle velocity .. .. . 2,650 ft./sec.
- (ii) Weight of projectile .. .. . 35 lbs. 14 ozs.
- (iii) Weight of charge .. .. . 9 lbs. 0 ozs. 6 drs. (S.C. 103).
- (iv) Total weight of round .. .. . 63 lbs. 8 ozs.

### (b) Reduced Charge

- (i) Initial muzzle velocity .. .. . 2,000 ft./sec.
- (ii) Weight of projectile .. .. . 35 lbs. 14 ozs.
- (iii) Weight of charge .. .. . 5 lbs. 1 oz. 11 drs. (S.C. 061).
- (iv) Total weight of round .. .. . 59 lbs. 9 ozs.

### 15. Positions of Centres of Gravity

#### (a) Mark XVI\* Gun

- (i) With breech mechanism and loaded .. .. 56.83 in. from breech face.
- (ii) With breech mechanism but unloaded .. .. 57.13 in. from breech face.
- (iii) Without breech mechanism and unloaded .. .. 60.98 in. from breech face.

#### (b) Mark XIX (all types) and Mark XX mountings, complete with guns

Centre of gravity is over the centre pivot.

### 16. Rifling of Mark XVI\* Gun

- (a) One turn in 30 calibres, 32 grooves.
- (b) Probable life in E.F.C.s. of rifling—600.
- (c) Series after which gun must be inspected—100 rounds.
- (d) Provisional condemning limit of wear—0.248 in. at 1 in. from commencement of rifling.

### 17. Recoil and Run-Out Data

#### (a) Recoil

- (i) Working (full charge) .. .. 15 in. *Paragraph 17 (d) (ii) "distilled water" add:—*
- (ii) Metal to metal .. .. 16.5 in.
- (iii) Reduced charge .. .. 8 in.

#### (b) Recuperator

- (i) Initial charging pressure .. .. 970 lbs./sq. in.
- (ii) Pressure after recoil .. .. 1,490 lbs./sq. in.
- (iii) Packed back charging pressure .. .. 1,550 lbs./sq. in.
- (iv) Percentage of recoil absorbed in recuperator .. .. 31 per cent.

#### (c) Intensifier

- (i) Initial pressure on intensified side of piston .. .. 1,260 lbs./sq. in.
- (ii) Pressure after recoil on intensified side of piston .. .. 1,990 lbs./sq. in.

#### (d)—(i) Capacity of recoil system .. ..

**Mark XIX**      **Mark XX**  
20 pints      10 pints

(approx.) *Paragraph 17 (d) (ii) "distilled water" add:—*  
(approx.) *Paragraph 17 (d) (ii) "distilled water" add:—*  
Equal parts of glycerine and saturated solution of lime, the solution being made with

#### (ii) Composition of buffer liquid .. ..

Page 9. Paragraph 17 (d) (ii). After "distilled water" add:—

✓ "Oil O.M. 13 when modified control rings (Modification No. 86) are fitted."

#### (e) Test pressures

(G. 94080, 30—A.F.O. P. 9/31.)

- (i) Recoil cylinder .. .. 8,000 lbs./sq. in.
- (ii) Recoil cylinder, assembled .. .. 4,000 lbs./sq. in.
- (iii) Compensating tank .. .. 40 lbs./sq. in.
- (iv) Recuperator .. .. 3,000 lbs./sq. in.
- (v) Intensifier .. .. 4,000 lbs./sq. in.

### 18. Forces on Firing

#### (a) Forces of Recoil

**Mark XIX**

**Mark XX**

- (i) With guns horizontal .. .. 36 (2 guns)
- (ii) With guns at 80° elevation .. .. 42 (2 guns)
- (iii) Reduced charge firing, guns horizontal .. .. 30 (2 guns)

Tons

Tons

Tons

#### (b) Deck Blows

- (i) Maximum upward lift at front of base plate .. .. 29      15
- (ii) Maximum downward blow at rear of base plate .. .. 50      25

### 19. Elevating Gear Details

- (a) Maximum elevation .. .. 80°.
- (b) Maximum depression .. .. 10°.
- (c) One revolution of the handles elevates the guns 3°.
- (d) Type of elevating receiver:—

#### Bottom drive—

- C, Marks III\* and VI, duplex.
- C, Marks IV, IV\*, V, V\* and IX, single.
- F, Marks I, II and III, single.
- CM, Marks I and I\*, single.

#### Back drive requiring adaptor bracket and bolts—

- C, Marks I, II and II\*, single.

- (e) Minimum force required at teeth of elevating arc to make friction plates render .. ..

**Mark XIX**

**Mark XX**

Tons

Tons

Tons

Tons

Tons

Tons

Tons

Tons

Tons

Tons



## 20. Training Gear Details

- (a) Maximum angle of training .. .. . 340° or 670° (according to type of stops fitted).
- (b) One revolution of the handles trains the mounting 4°
- (c) Type of training receiver
- Bottom drive—*
- C, Marks III and VI duplex.
- C, Marks IV, IV\*, V and V\*, single.
- CM, Marks I and I\*, single.
- F, Mark I.
- Back drive requiring adaptor brackets and bents—*
- C, Marks I, II or II\*
- Back drive requiring adaptor bracket and spur gearing*
- Small type (modified)
- (d) Minimum force required at training rack to make friction plates render .. .. .

Mark XIX	Mark XX
Force	Force
7.2	8.5

## 21. Training Base

- (a) Holding down bolts
- (i) Number .. .. . 36
- (ii) Diameter .. .. . .875 in.
- (iii) Pitch circle diameter .. .. . 7 1/2 in.
- (b) Clip clearances .. .. .
- .01 in. minimum.
- .02 in. maximum.
- (c) Training rollers
- (i) Number .. .. . 50
- (ii) Flange clearance on lower race base plate .. .. .
- .003 minimum.
- .007 maximum.

Chase Hard   Hazen
Screws   Bolts

## 22. Cradle

- (a) Clearance of gun to bearing strips in cradle .. .. .
- .009 in. minimum.
- .02 in. maximum.
- .02 in.

Page 10. After paragraph 23 (b) add

## 23 (1) Safety Firing Switch Gear.

- (a) Designed limits of operation
- (b) Type of Interceptor

10° depression, 80° elevation

Mark 4 modified or Mark 6.

(G 0777R/48—2 P.O. P.71/50,

## 24. Sighting Gear

- (a) Gearing constants
- (i) Range .. .. . 10 2273 to 1.
- (ii) Lateral deflection .. .. . 17 4924 to 1 (1 unit equals 6 minutes of deflection).
- (b) Range dial graduations
- (i) Full Charge .. .. .
- Every 25 ft./sec. of M.V. between 2,650 ft./sec. and 2,500 ft./sec. Projectile 6 c.r.b. (Table No. 470) Maximum range, 18,000 yards.
- Every 25 ft./sec. of M.V. between 2,000 ft./sec. and 1,875 ft./sec. Projectile 8 c.r.b. (Table No. 439) Maximum range, 13,500 yards.
- (ii) Reduced Charge .. .. .
- 0 to 100 units (0° to 10°) right or left
- (c) Deflection dial graduations .. .. .
- 0 to 100 units (0° to 10°) right or left
- (d) Drift is corrected automatically by gearing. drift constant 1.21, amount of drift at 30° T.E. 1" = 0' 3"
- (e) Travel of sight .. .. . 30° below and 5° above centre line of gun
- (f) Adjustments
- (i) For change in M.V. .. .. . Ship appropriate dial
- (ii) For reduced charge firing .. .. . Ship reduced charge cams, crankarms and appropriate dials
- (g) Barrage Sights
- (i) Aim-off speeds .. .. .
- Inner ring, 100 knots.
- Outer ring, 200 knots.

**25. Hanking Back Gear**

(a) Test load (assembled) .. .. . 12 tons.

**26. Shield**

(a) Thickness .. .. . 125 in.

(b) Material .. .. . "D" quality steel plate.

27 to 32.

**CH. I. SECTION 2—LUBRICATION****Plate 25 and 40.**

33. This plate is a lubrication diagram for all parts of the mounting. The colours used on the diagrams to indicate the frequency of lubrication are for guidance only. No hard and fast rule can be laid down as to this.

Page 11 After paragraph 33 add:—

33A. Lubrication of safety firing switch gear is shown on plate 24A.

(G. 07778/48—A.F.O. P.74/40)

**Grease**

34. This form of lubrication is extensively employed. As a rule the grease is applied to the working surfaces through a nipple by means of a grease gun, but in some places spring feed lubricators are used. Grease is particularly suitable for intermittent loads. Apart from its lubricating properties it serves to exclude water and moisture from bearings and other working parts exposed to weather and acts as a preservative.

35. It is important to remember that grease will always take the easiest passage. Thus, if two or more bearings are greased from the same lubricator there will be a tendency for the bearing nearest the lubricator to receive most of the grease. Similarly, if a very long bearing is fed from a single lubricator most of the grease is likely to pass towards the end of the bearing nearest the lubricator or along that part of the bearing which has the largest clearance. In the course of time this tendency is accentuated by the grease in those grooves which, owing to their size or length, offer the greatest resistance to the entry of fresh lubricant, becoming hard and eventually clogging the passages completely. For these reasons it is usual, wherever possible, to employ a separate grease nipple or lubricator to serve each bearing or slide.

36. It is necessary to ensure that all working parts receive attention at regular intervals and are adequately lubricated. In normal circumstances however grease is retained as a working film for long periods and application of a grease gun to a bearing which is already fully charged will only result in forcing out and wasting serviceable lubricant. On the other hand it does not necessarily follow, for the reasons stated above, that because grease is seen exuding from one part of a bearing all working surfaces charged from the same lubricator are being sufficiently greased. Care should therefore be exercised when working parts are stopped for examination to note whether the lubricating arrangements have been functioning efficiently so that if necessary steps may be taken to ensure the parts more frequently in future. Before closing up again all old grease should be removed from the grease grooves and passages and fresh grease applied.

37. The use of grease is avoided as far as possible for small totally enclosed parts such as spring plungers as it is liable to choke the boxes and make the gear work sluggishly.

**Oil Baths**

38. Wherever possible spur, bevel and worm gearing is totally enclosed in a box which is kept partly flooded with Admiralty Special Mineral Oil. With this arrangement some of the parts are totally immersed in oil while those above the oil level are lubricated by the oil flung off the gears as they rotate.

Each oil box is usually fitted with a filling plug and an oil level plug, but occasionally one plug serves both purposes.

Oil is prevented from leaking out of the boxes where the shafts pass through by means of felt rings often combined with a grease seal or by patent oil seals which are self-contained units embodying a hat leather, the lip of which is pressed on to the shaft by a spring.

**Oilers and Oil Cups**

39. Lightly loaded parts, particularly in connection with instruments, such as drives for director and fire control gear, are usually designed for lubrication by oiling.

40. Oilers or oil cups are also fitted in places where it would be impracticable on account of accessibility to connect a greaser to the part requiring lubrication e.g. training roller axles, or where several pairs of surfaces, possibly separated by some distance, must be fed from the same lubricator.



## CHAPTER II

### SECTION 1 THE GUN

#### Plate 6

46 The gun is of all steel construction. It consists of a loose barrel, autofrettaged, jacketed, removable breech ring and sealing collar.

#### LOOSE BARREL

47 The barrel is rifled on the polygroove system with 32 grooves having a uniform twist of one turn in 36 calibres. The length of bore is 45 calibres i.e. 15 ft.

#### JACKET

48 The jacket is screwed externally at the rear end with interrupted threads to receive the breech ring and at the front end is screwed to take the sealing collar.

On assembly the loose barrel is inserted in the jacket until a shoulder at the rear end of the barrel seats itself in a ring of increased diameter at the rear end of the jacket. There is a clearance between the exterior of the barrel and the interior of the jacket and the barrel is prevented from rotating by two securing screws.

Watertightness between the fore end of the jacket and the barrel is obtained by asbestos rings compressed within the sealing collar.

#### BREECH RING

49 The breech ring is secured to the jacket by means of the breech ring nuts. It is then rotated by means of the breech ring handle and is then locked to the jacket by the breech ring lock.

The breech ring is machined to receive the various mechanism components and on its upper surface is the clinometer plate.

Page 12, Paragraphs 50 and 51 as inserted by A.F.O. P 278 48; Delete and substitute —

#### Inspection.

50 Particulars regarding the probable life inspection series concerning joints breech mechanism clearances and the service life and inspection of breech rings are given in B.R. 201.

For procedure for changing barrels see Chapter 6, Section 4.

51 57

(G. 3010.48.—A.F.O. P 374 49)

## CH. II. SECTION 2—THE BREECH MECHANISM

#### Plates 7, 8, 9, 10, 11

58 The breech mechanism of the 4-in. Mark XVI\* gun is of the plain surface block type arranged to slide vertically in the breech end of the gun. The breech block with its components is interchangeable for both left and right guns but the breech mechanism lever is handed and is mounted on the actuating shafts at the left and right hand sides of the respective breech ends. The remainder of the gear with few exceptions is interchangeable.

59 The firing mechanism is of the combined electric and percussion type in which the percussion striker is cocked during the opening of the breech and remains cocked, unless percussion fire has been employed.

When a new part is required the size and Mark of the gun, i.e., 4-in. Mark XVI\*, the index number and the description as given in the Schedule are to be used on the demand note. (See Appendix II.)

60 The mechanism consists of the following principal parts:—

- Breech Block.
- Actuating Shaft with Lever.
- Crank.
- Extractor.
- Catches Retaining Breech Block Open.

Counterbalance and Buffer.  
 Breech Mechanism Lever  
 Breech Mechanism Lever Stop Bracket.  
 Firing Mechanism.  
 Cocking and Retracting Gear.  
 Safety and Recoiling Gear.

#### THE BREECH BLOCK

61 The breech block is of the vertical sliding block type with a plain guide on both sides. These guides slide in corresponding grooves in the breech ring, the grooves being slightly inclined to give a forward movement to the block in closing.

This ensures that the cartridge case is forced home on closing and also prevents undue rubbing between the breech block and the head of the case in opening.

62 The upper centre part of the block is curved to clear the cartridge when loading and the upper front face is bevelled to assist the seating of the cartridge case. In the centre of the curved cutting is the **preserving screw** to protect the hole for the lifting eye. Just above the curved surface on the left hand side of the block three **preserving screws** are fitted to protect the holes that receive the screws of the arm actuating extractor for the sub-calibre gun.

On the left-hand side of the block a curved groove is provided to take the **crank sliding block**.

63 On the gun axis the block is bored to take the **firing cone**, which is retained by interrupted collars at the rear of the bore. The front of the bore is screwed to receive the **firing hole bush**.

64 On the left-hand side of the block a hole is provided for the **firing plunger** and on the right-hand side is a stepped hole to take the **breech block inner contact bush**. The lower part of the block is hollowed out and provided to receive the **cocking, retracting and actuating lever**.

At the rear of the block a vertical hole for the **recoiling bar** and towards the lower edge a stepped hole is provided for the **breech block outer contact**.

65 The front face of the block is cut away to receive the **extractor** and the **catches retaining breech block open**, radial surfaces being provided at the upper end of the block to engage these catches when the breech is open.

#### THE ACTUATING SHAFT. (Plate 8)

66 The **actuating shaft** consists of a long spindle of one diameter with a flanged head. The spindle has three keyways cut into it and they engage with corresponding keys of the **crank and collar** provided in bushes/bearings in the rings at the bottom of the breech ring. The shaft extends outwards from the left-hand side of the breech ring on the left gun and on the opposite side on the right gun. The extended portion of the spindle carries the **rack pinion** (housed in the **S.M. lever**) and **actuating shaft lever**. The pinion and actuating shaft lever are keyed to the actuating shaft, the former being retained by the flanged head. The spindle of the actuating shaft passes through the **sleeve** that retains the crank and collar and is kept in position by the **locking screw** in the sleeve.

#### THE ACTUATING SHAFT LEVER

67 The actuating shaft lever which is keyed to the actuating shaft is housed between the side of the breech ring and the breech mechanism lever bearing.

68 It is provided with a double eye for connecting to one end of the **link actuating breech mechanism**. The latter is connected at its other end to the **case actuating breech mechanism**. The gun is operated by the **crank arm** of the **semi-automatic gear** on the gun and when the run-out of the gun is rotated to open the breech through the medium of the link and actuating shaft lever.

#### THE CRANK. (Plate 10)

69 The crank which is keyed to the actuating shaft rotates in the bushed bearing in the left-hand ring at the bottom of the breech ring.

It has a **projection** with crank pin for operating the block, the crank pin engages with the **sliding block** which in turn slides in the curved groove provided in the left-hand side of the breech block.

70 Because the crank movement passes beyond the dead centre a locking point is obtained when the breech is closed. Maximum power is obtained when commencing to open the breech and when seating the cartridge and shock when operating semi-automatically is practically eliminated.

In the closed position a stop surface at the front of the crank abuts on the chamber face of the breech ring.

#### THE EXTRACTOR. (Plate 11)

71 The extractor is of the one-piece rocking type, the axis (which bridges the arm) engaging in a slot in the breech end. The arms are arranged to rock on the breech end giving powerful initial wedging action after which the axis pivots in the breech end to give rapid ejection. The toes of the extractor engage the rim of the cartridge case while the heels are actuated by inclined cuttings in the breech block.



**CATCHES RETAINING BREECH BLOCK OPEN. (Plate 9)**

72. These catches are spring controlled levers pivoted on axis pins mounted in the breech ring on the left and right hand side of the loading gap. The axis pins are retained by fixing screws in the breech ring.

73. When the breech is opened, the catches are brought out by the arms of the extractor and held out by their respective spring plungers.

74. The catches thus prevent the closing of the breech block beyond the loading position until a cartridge is inserted.

75. On loading the flange of the cartridge engages with the lips of the catches, thereby moving them out of the path of the breech block so that the breech may be closed.

**COUNTERBALANCE AND BUFFER. (Plate 9)**

76. The counterbalance has a fourfold purpose, viz.:-

- (1) It limits the normal opening travel of the breech block
- (2) It controls the weight of the falling breech block during the opening of the mechanism
- (3) It assists the closing of the breech block
- (4) It returns the breech block to loading position in Q.F. action thus freeing the extractor and then carries it on to the cartridge retaining position on loading.

77. The counterbalance consists of the **rod, sleeve, spring and nut**. It is controlled in a vertical hole in the right hand side of the breech ring and is secured to the **breech block yoke** by the nut.

78. The breech block yoke, which is permanently riveted to the breech block, has a spherical recessed seating for the head of the nut to allow for the slight rocking action of the counterbalance rod when the breech block is opening on the inclined guides.

79. The **buffer** provides a shock absorber when the breech is opened violently as may occur in S.A. action.

80. It is contained in the bottom of the vertical hole for the counterbalance and consists of a **washer, rectangular section spring and screwed bush**.

81. In action the counterbalance sleeve is arrested on the buffer washer to limit the normal opening of the mechanism, overtravel of the block then compresses the buffer spring until movement is finally arrested by the washer stopping against the upper face of the bush.

**THE BREECH MECHANISM LEVER. (Plate 9)**

82. The breech mechanism lever is handle and is fitted on the left hand side of the left gun and on the opposite side on the right gun. It is pivoted on the rack pinion but free to revolve in its own axis.

83. The outer side of the B.M. lever is bored out to receive the **rack** and the **breech block actuating spring**.

84. The spring is retained by a screw **cap with bearing disc**, the cap being locked by a check screw. The compression of the spring can be adjusted by the cap. A **DEPRESSOR** is made in the cap indicating the amount of spring adjustment for each gun.

85. The rack engages with the rack pinion so that relative movement between the actuating shaft and the B.M. lever will cause the actuating spring to be compressed.

86. Sliding in the B.M. lever is the **catch bar** which is operated by the catch bar actuating lever. The inner end of the catch bar, when moved towards the axis, engages in a recess in the actuating shaft lever.

87. The **spring plunger**, which is mounted in the catch bar keeps the latter out of engagement.

88. The plunger is retained by a pin when the catch bar is removed from the B.M. lever.

89. When the catch bar is engaged with the actuating shaft lever any outward movement of the B.M. lever will rotate the actuating shaft but the shaft can turn in the opening direction without moving the B.M. lever when the catch bar is disengaged. This latter action occurs in S.A. firing.

90. On the inside of the catch bar is a projection which engages with the **B.M. lever catch**. The latter which locks the B.M. lever in the fully closed position is pressed out of engagement with the pocket in the **B.M. lever stop bracket**, when the catch bar is moved by the catch bar actuating lever.

91. On the top side of the catch bar is a projection which abuts against the hook on the **B.M. lever latch** when the B.M. lever is 3° from being fully closed thereby retaining the B.M. lever in this position. When the catch bar is fully operated by the catch bar actuating lever the projection on the bar is clear of the hook on the B.M. lever latch.

92. The catch bar actuating lever which engages with the catch bar, is pivoted in the handle portion of the B.M. lever on an axis pin.

93. On the end of the arm of the B.M. lever is the **B.M. lever guide** which is permanently riveted to the B.M. lever. This guide is controlled in a cutting in the B.M. lever stop bracket and prevents side play of the top end of the B.M. lever when the latter is being finally closed.

94. The B.M. lever catch slides in a hole in the B.M. lever and is spring controlled. The upper end of the catch enters a pocket in the B.M. lever stop bracket to lock the B.M. lever in the fully closed position. The lower end of the catch engages with the cam projection on the catch bar.

95. Below the B.M. lever catch is the catch spring bearing guide which bears on the quadrant of the locking lever. When the catch spring bearing guide is on the upper surface of the quadrant, i.e. the S.A. position of locking lever, the B.M. lever catch abuts against the bearing guide and is therefore locked.

96. By rotating the locking lever to the Q.F. position, the catch spring bearing guide is bearing on the lower surface of the quadrant which allows relative movement of the B.M. lever catch to take place.

97. The locking lever is pivoted in the B.M. lever and consists of a spindle with a solid arm.

98. The spindle is cut away to form the quadrant which engages the catch spring bearing guide.

99. The arm contains the spring operated locking lever plunger and head. The plunger enters pockets in the B.M. lever and locks the locking lever in either the S.A. or Q.F. position.

The plunger is freed from either pocket by withdrawing the head.

#### THE B.M. LEVER STOP BRACKET. (Plate 5)

100. The B.M. lever stop bracket fits into grooves in the breech ring and is secured by two firing screws with locking plates. The top face of the bracket forms the stop for the B.M. lever in the locked position. The central portion of the bracket houses the gear that returns the B.M. lever at hand latch.

In the lower end of the bracket is the pocket for the B.M. lever catch which locks the B.M. lever in the closed position. On the side of this pocket is a beveled surface for depressing the catch during the final closing to allow the catch to snap into its pocket.

101. Screwed into the stop face side of the bracket is the axis stud for the B.M. lever latch, the latter being retained by a nut with keep pin.

102. On the opposite side of the stop face is a preserving screw for protecting the hole that is provided for the axis stud when the bracket is fitted to the opposite hand breech ring.

103. The releasing gear consists of a plunger, spring collar, screw and link. The plunger engages direct with the B.M. lever catch and through the link is connected with the B.M. lever latch.

104. The plunger is operated by the thumb releasing B.M. lever on the balance ring.

105. Should the breech not be fully closed by the actuating spring in any circumstances, then the B.M. lever catch operation can be disengaged from the B.M. lever by applying pressure on the thumb lever. The B.M. lever is then brought to that position at which the thumb lever has been withdrawn to engage the catch bar with the actuating shaft lever and closing of the breech can be completed by means of the B.M. lever, as in hand operation.

106. The B.M. lever latch pivoted on the bracket retains the B.M. lever at 3" from the fully closed position through the medium of the hook on the latch and the top projection on the catch bar. The latch is withdrawn through the link and releasing plunger by the spring and when the B.M. lever is moving the latch is pressed upwards by the top projection on the catch to snap behind the projection and thus retain the B.M. lever just before finally reaching the closed position.

107. The object of this latch is to ensure that the B.M. lever is retained against rotation during firing since during the final 2° rotation of the B.M. lever the needle of the firing mechanism is in electrical contact with the primer in the cartridge case.

#### HOUSING THE BREACH MECHANISM LEVER

108. The B.M. lever can be housed, when the breech is open, by releasing the catch bar actuating lever thereby withdrawing the actuating shaft lever from the B.M. lever and forcing home the B.M. lever until it is held by the B.M. lever catch snapping into its pocket in the B.M. lever stop bracket. This will put the actuating spring into compression a relative movement between the rack and the pinion having taken place.

The breech block will also close slightly at first until held by the retaining catches.

As soon as the catches are released by the next round the lock carried on the rack by the B.M. lever actuating spring will rotate the actuating shaft and close the breech.

109. The initial compression on the actuating spring is 480 lbs. and the maximum working compression is 1,000 lbs.

#### CHANGING FROM "S.A." TO "Q.F." WITH THE BREACH BLOCK OPEN.

110. As the breech block has to be lifted vertically a very strong spring is required. This spring is fully compressed when the block is open and the B.M. lever housed.

111. If the B.M. lever is then withdrawn from the housed position it will fly to the open position with great violence and will severely injure anyone in its path.



112. Two levers are pivoted on the steadying handle, the top lever being provided with a thumb-piece while the bottom lever engages with the top end of the plunger which releases the B.M. lever catch. When the thumb-piece is pressed, the plunger is pushed down and releases the catch from its stop bracket. The B.M. lever is thus unlocked and will fly open under the action of the spring. **The thumb-piece should not be pressed, therefore, till the breechworker has taken the thrust of the B.M. lever.**

113. The following procedure should be adopted:—

- (i) Set the locking lever to "Q.F."
- (ii) Grasp the B.M. lever firmly with one hand and press forward to take the thrust of the spring.
- (iii) Grasp the steadying handle firmly with the other hand, and press the thumb-piece easing the B.M. lever.

These loads can be reduced by any amount up to 180 lbs. by merely slackening the cap.

## THE FIRING MECHANISM

### Plates 10, 11

114. In general the percussion gear consists of a **trigger** and **firing bar** mounted on top of the breech ring, a **firing lever** pivoted in the breech ring and a **firing plunger** in the breech block that connects with the **trigger seat** in the firing case. The firing case also carries the **striker** and **needle block** and is removable as a unit.

115. The safety gear provides a safe retraction of the needle by acting through the recocking and retracting gear when the **safety lever** is put to "SAFE" and the recocking gear permits of recocking the percussion striker without opening the breech.

## PARTS OF THE FIRING MECHANISM

6. **FIRING CASE.** This is a cylindrical body that fits into the axial bore of the breech block where it is held by interrupted rollers and locked by a spring loaded catch. It is usually inserted in a recess in the breech block and cannot be slid down unless the firing case is home.

17. The firing case carries the **trigger seat** with its **ram pin** and **return plunger** which are housed in the side of the case.

18. The firing case also carries the **needle block** and **striker** details, which are retained by the **cover**, the latter being locked in place by the hinged catch.

19. The firing case cannot be removed from the breech block unless the needle has been retracted through the agency of the safety lever to the "SAFE" position and the striker also withdrawn to the fully cocked position.

120. When the needle is retracted to the "SAFE" position, the recocking bar is automatically withdrawn from a pocket in the flange of the firing case.

121. When the striker is cocked, either by having previously opened the breech or through the recocking gear a nail on the trigger seat is clear of the shoulder of the rear interrupted roller and thus allows the firing case to be rotated for removal.

22. **NEEDLE BLOCK.**—This is a cylindrical body in two parts. **Part I** carries the needle with **insulating washer** and **bush** in contact piece with **insulating bush** and securing **nail**. The contact piece makes electrical contact with the **breech block inner contact bolt**.

123. The **needle block, Part II**, is screwed to **Part I** and secured by a fixing screw. The central portion of **Part II** has a long stem which supports the **needle block spring** and on the lower left-hand side is a projection which is engaged by the retracting lever to give safe withdrawal of the needle before the breech block moves in opening. This projection, together with a similar projection on the opposite side of the striker, forms a key to prevent rotation of the needle guide block. In order to obtain the present type of fracture **Part II needle blocks in Q.F. 4 in. Mark XVI\* guns** will be modified by drilling out the stem and when so modified are known as **Mark I\***.

124. The **needle block spring** bears against a recessed seating in the needle block **Part II** to press the needle forward on to the primer. The other end of the spring is housed in the **striker spring bearing guide**.

125. **STRIKER.**—This is a cylindrical body containing the **striker spring**. The latter is supported on the **striker spring bearing guide** which is held in the firing case cover by the pressure of the **striker spring**. A new pattern **striker spring**, known as the **Mark IV**, came into supply in 1941.

126. The **striker** has a projection on the lower right-hand side against which the **recocking lever** engages when the **striker** is being cocked. This projection extends rearwards and forms a key in the firing case body to prevent rotation of the **striker**.

127. A cutting at right angles to this key provides two shoulders for engagement with the **trigger seat**.

128. The rear shoulder of the trigger sear to hold the striker in the cocked position while the front shoulder of the trigger sear is in contact with the rear shoulder of the striker in the overcocked position.

129. The striker effects percussion firing by its hammer action on the needle block the needle of which is always in contact with the primer for electric firing.

130. **FIRING PLUNGER.** This plunger with its details is housed on the left-hand side of the breech block.

131. It connects the trigger sear with the firing lever and is normally spring returned. Should it fail to return the firing lever trigger sear assembly pushes back the firing plunger setting it cock of the striker.

132. **FIRING LEVER.** This lever is housed in a recess in the left-hand side of the breech block and is pivoted on the firing lever axis pin.

The lower end engages the front of the firing plunger and is provided with a bevelled projection. The upper end of the firing lever is provided with a curved face which fits into a groove in the trigger

133. The bevelled projection on the lower end is opposite a corresponding cutting in the breech block when the breech block is closed. The firing lever is only permitted to move when the trigger sear is in the closed position of breech block.

134. When the breech block is opening the lever in the firing position the bevelled projection and pusher face push back the firing lever to its normal position. After lever has not returned after firing.

135. **TRIGGER AND FIRING BAR.** These bars are mounted on the top of the breech block. The trigger bar is a long bar with a curved end which fits into the trigger sear. The firing bar is a long bar with a curved end which fits into the firing lever. The trigger bar is engaged by the trigger sear when the breech block is closed. The firing bar is engaged by the firing lever when the breech block is closed.

136. On the left gun the trigger is coupled by a link and lever to the left-hand palm lever of the firing gear. On the right gun the trigger bar is engaged by a link connected up with the right-hand palm lever.

137. The palm lever is the normal means of operating the firing gear and a lanyard is also attached to the trigger and firing bar for firing by means of a lanyard on the left and right guns respectively.

## COCKING AND RETRACTING GEAR.

### Plate 10

138. **ACTUATING LEVER FOR COCKING AND RETRACTING LEVER.** The lever is pivoted in the rear part of the breech block in the cocking and retracting crank space and has three separate arms.

139. The vertical arm carries a roller which engages with the cocking lever and also has an extension which engages with the roller on the retracting lever.

140. The lower extremity of this projection is radial and rides over the retracting lever roller during the continued action of the actuating lever to cock the lock.

141. The rear arm engages in a slot in the recocking bar containing the return spring. The front arm engages in the sides of the cocking and retracting cranks. These two levers return to normal position through the agency of the spring.

142. **COCKING LEVER.** This lever is pivoted in the front part of the breech block on the spindle which also carries the retracting lever. This spindle has an elongated head fitting into the breech block and is engaged by the cocking crank. The upper arm of the cocking lever engages the projection on the strike and the lower arm engages the roller on the actuating lever.

143. **RETRACTING LEVER.** This is a pivoted lever. The upper arm engages the projection on the cocking lever and the lower arm carries a roller which engages with the extension on the actuating lever.

144. **COCKING CRANK AND RETRACTING CRANK.** These cranks are pivoted in the breech block on the head of the spindle. The cocking crank is a long bar with a curved end which fits into the cocking lever. The retracting crank is a long bar with a curved end which fits into the retracting lever. The cocking crank is engaged by the cocking lever when the breech block is opening to complete the cocking of the striker.

145. The retracting crank carries a large roller that is actuated by the crank riding back during the initial movement of the crank in the actuating shaft.

146. **RECOCKING BAR.** This is a long bar pivoted in the breech block. The upper end of the recocking bar is engaged by the rear arm of the actuating lever. The lower end of the recocking bar is provided with a lug that engages the recocking bar extending lever on the recocking shaft.

### SAFETY AND RECOCKING GEAR. (Plate 9)

47 This gear is fitted on the same side of the breech ring as the breech mechanism lever and consists of the safety lever, intermediate safety lever, recocking shaft, recocking shaft actuating lever and recocking bar actuating lever. The gear is interchangeable for left and right guns with the exception of the safety lever which is handed.

148 The safety lever is pivoted on the side of the breech ring and retained by a screw. The arm of the lever is provided with a spring plunger which enters pocket in the breech ring and retains the lever in either the SAFE or FIRE position. The plunger is freed from this position by withdrawing the head cover to the plunger. On the outside of the arm of the safety lever is a boss containing a cam-shaped cutting that engages with the toe of the intermediate safety lever.

149 The intermediate safety lever is pivoted on an axle pin fitted into the side of the breech ring. The pin is retained by a screw underneath the lower end of the loading handle.

150 The upper arm of the intermediate safety lever is cylindrical to accommodate a roller for rotating the lever to recock the striker. The lower arm is provided with a toe that engages with the cam cutting in the boss of the safety lever. The front surface of this arm is cam shaped and engages with the roller on the recocking shaft actuating lever.

151 The recocking shaft consists of a long spindle with a flanged head and is pivoted in a hole bored right through the lower rear end of the breech ring. The spindle has two ways of action and by engaging with corresponding keys on the recocking shaft actuating lever and recocking bar actuating lever the recocking shaft actuating lever being retained by the flanged head of the shaft, the latter being secured by a nut with keep pin on the opposite end.

152 The recocking shaft actuating lever is keyed to the shaft on the side of the breech ring and on its upper arm carries a roller which engages with the cam surface on the intermediate safety lever.

153 The lower arm is provided with a spring plunger to keep the gear under control.

154 The recocking bar actuating lever is keyed to the recocking bar and is pivoted on the bottom of the vertical center line of the breech ring. Its arm engages with the key on the recocking bar.

155 When the safety lever is rotated to the SAFE position the cam-shaped cutting engages with the toe of the intermediate safety lever to rotate the latter.

156 This movement (through the agency of the recocking gear actuating lever, recocking bar actuating lever) withdraws the needle and striker to a safe position.

### CONTACTS FOR ELECTRIC FIRING.

#### Plate 10

157 These parts which provide the necessary circuit to the contact piece of the needle block are three in number:

(1) **THE INNER BREECH BLOCK CONTACT.** This is a bolt unit provided with insulation and controlled by a spring. It is secured in a bracket on the right hand side of the breech block, where it is retained by the cover which is dovetailed into the breech block and secured by a screw. The cover is freed by screwing the latter upwards. A cable passing through a hole in the breech block connects to the outer breech block contact bolt. The cable is held by a clip and screw.

(2) **THE OUTER BREECH BLOCK CONTACT.** This is a bolt unit provided with insulation and mounted in the retaining sheath under control of a spring. The retaining sheath is housed in a hole in the lower rear part of the breech block.

It makes contact with the breech ring contact bolt when the breech is closed.

(3) **THE BREECH RING CONTACT BOLT.** This is a bolt with nuts and insulation fitted in a recessed hole in the lower rear part of the breech ring. The recess is provided with a dovetailed cover and locking screw similar to the cover of the inner breech block contact pocket.

The supply cable from the interpreter is connected by two terminal nuts on the bolt.

### LUBRICATION.

158 Two Enol's Nipples in H.M. lever. (One nipple on the side of the lever for lubricating rack and one nipple on the base for lubricating H.M. lever bearing.)

Two Enol's Nipples in Breech Ring. (One on each lug for lubricating the crank bearing and actuating shaft collar bearing respectively.)

### ACTION OF THE MECHANISM.

#### Plates 8 and 9

#### OPENING THE BREECH SEMI-AUTOMATICALLY

159 As the gun turns out after recoil the cam actuating breech mechanism engages the roller on the crank arm of the semi-automatic gear on the recocking shaft. The cam on the recocking shaft through the link actuating breech mechanism, recocking shaft actuating lever and recocking bar actuating lever, the latter thus rotating the crank to open the breech.



160 During this movement the rack pinion is also rotated and acting on the rack in the casing of the B.M. lever compresses the breech block actuating spring.

161 The B.M. lever during this action is locked to the breech ring by the B.M. lever catch.

162 At the commencement of the crank rotation and until the crank pin passes over the dead centre by an amount equal to the overlocking movement, no actual displacement of the breech block occurs. During this interval of the crank the corner of the sliding block bears on the retracting crank roller and rotates the retracting crank. This action through the mechanism of the actuating and retracting levers, withdraws the breech within the face of the breech block.

163 As the opening of the breech continues the cocking crank roller engages the cocking surface in the breech ring and rotates the cocking crank. This action causes further rotation of the actuating lever to take place and through the medium of the cocking lever withdraws and locks in striker. During the additional movement of the actuating lever a radial surface on its lower extremity rides over the roller on the retracting lever and thus returns the latter to the retracted position whilst the breech is opening. As the breech block approaches its fully open position the curved inclined cuttings in the breech block come into engagement with the lugs on the extractor and, acting the extractor arms on the gun forwardly wedge the cartridge case out of the chamber. At the end of this wedge action the extractor fulcrums on its axis and the final movement of the breech block rapidly ejects the case. During the opening of the breech block the counterbalance spring has been compressed, and on reaching the normal fully open position the buffer spring comes in action. This latter spring permits a small overtravel of the breech block during which the energy stored in rapid opening can be absorbed before a metal to metal stop is reached.

164 As the breech block is returned from the fully open position by the breech block actuating spring and the counterbalance spring, the latter using the return mechanism for Q.F. working the block is arrested at the fully open position by the catches retaining breech block open. The catches are brought into the path of the block as the case is ejected. In the loading position the extractor is freed for loading.

165 On loading the rim of the cartridge engages with the lips on the extractor and with the catches retaining breech block open forcing them forward until the catches are disengaged and the breech block and thereby allowing the latter to close.

166 **FOR QUICK FIRING.**—The S.A. crank arm is put out of action by rotating it to the Q.F. position and the mechanism is operated by the B.M. lever.

167 When the handle of the B.M. lever is grasped the catch bar actuating lever pushes the catch bar into the recess of the actuating shaft lever. This locks the B.M. lever to the actuating shaft. At the same time the catch bar depresses the B.M. lever catch from its retaining position to the B.M. lever stop bracket on the lever ring. Also, the top projection on the catch bar is withdrawn from the hook on the B.M. lever latch.

Movement of the B.M. lever will then rotate the actuating shaft and open the breech.

168 A loading handle is provided on the side of the breech ring adjacent to the B.M. lever to assist the loading number when ramming the round in the breech.

## STRIPPING AND ASSEMBLY

### 169 BREECH AND FIRING MECHANISM

- (1) Set safety lever at Safe and cock the striker by means of the recocking gear if the striker is not already cocked.
- (2) Remove firing case complete and lay aside for subsequent dismantling.
- (3) Remove counterbalance nut.
- (4) Remove preserving screw in curved cutting in breech block and screw in lifting eye. Attach tackle to lifting eye to take the weight of the breech block.
- (5) Disconnect link actuating breech mechanism from actuating shaft lever.
- (6) Open breech by B.M. lever beyond the fully open position until the crank sliding block passes out of groove in breech block.
- (7) Remove breech block.
- (8) Remove extractor.
- (9) Back back locking screw of actuating shaft sleeve.

#### Remove

- (10) Actuating shaft.
- (11) B.M. lever complete including rack pinion.
- (12) Actuating shaft lever.
- (13) Actuating shaft sleeve.
- (14) Crank.
- (15) Actuating shaft collar.

### 170. CATCHES RETAINING BREECH BLOCK OPEN

Remove —

- (1) Fixing screws for axis pins.
- (2) Axis pins.
- (3) Catches retaining breech block open.
- (4) Pins and spring plungers from catches.

171. FIRING MECHANISM IN BREECH BLOCK.—This can be stripped and assembled most easily with the breech block face downwards on the bench.

Remove —

- (1) Firing plunger retaining pin.
- (2) Firing plunger and spring.
- (3) Retracting and cocking crank spindle nut.
- (4) Retracting and cocking crank spindle.
- (5) Retracting crank.
- (6) Cocking crank.
- (7) Retracting and cocking lever spindle.
- (8) Retracting lever.
- (9) Cocking lever.
- (10) Actuating lever.
- (11) Pin retaining recocking bar.
- (12) Recocking bar, pins and spring.

### 172. DETAILS OF FIRING CASE

Remove —

- (1) Catch retaining pin by pressing in plug.
- (2) Plug, spring and plunger.
- (3) Catch lever hinge pin.
- (4) Catch lever.
- (5) Screw retaining trigger near axis pin (black back only).
- (6) Trigger near axis pin.
- (7) Trigger.
- (8) Cover with bearing guide and striker spring.
- (9) Striker.
- (10) Needle block spring.
- (11) Needle unit complete.

Note.—The needle unit should not be disturbed except for replacement of a needle or inspection. The trigger near plunger handle which are retained by a dovetailed plate need not be removed if working freely.

### 173. FIRING MECHANISM ON BREECH RING

Remove —

- (1) Nut on trigger axis stud at top of breech ring.
- (2) Trigger. (Note.—On left gun, in removing the connecting link of the firing gear on the balance ring.)
- (3) Firing bar complete with spring plunger. (Note.—On right gun first removing the connecting lever of the firing gear on the balance ring.)
- (4) Firing lever axis pin.
- (5) Firing lever.

### 174. SAFETY AND RECOCKING GEAR

Remove —

- (1) Recocking shaft nut.
- (2) Recocking shaft.
- (3) Recocking shaft actuating lever complete with spring plunger. (Remove plunger and spring by unscrewing head.)
- (4) Recocking bar actuating lever.
- (5) Loading handle.
- (6) Keep screw for intermediate safety lever axis pin.
- (7) Intermediate safety lever axis pin.
- (8) Intermediate safety lever.
- (9) Screw retaining safety lever.
- (10) Safety lever complete. Remove plunger and spring by unscrewing head.

### 175. ELECTRIC CONTACTS

These should not require dismantling in ordinary circumstances, but only for special cleaning or renewals.

**176. BREECH BLOCK INNER CONTACT**

- (1) Screw inward the screw in the right-hand side of the breech block.
- (2) Remove cover.
- (3) Slack off the terminal nuts on both inner and outer breech block contacts.
- (4) Draw out the cable.
- (5) Remove breech block inner contact bush complete with bolt, etc.

**177. BREECH BLOCK OUTER CONTACT**

Remove:—

- (1) Terminal nuts.
- (2) Retaining nut.
- (3) Insulating washer.
- (4) Collar.
- (5) Shuttle with spring, insulating sleeve, insulating washer and bolt.

**178. BREECH RING CONTACT**

- (1) Screw inward the screw in the lower seat part of the breech ring.
- (2) Remove cover.
- (3) Slack off the terminal nuts.
- (4) Draw out the cable.
- (5) Remove retaining nut.
- (6) Remove bolt.
- (7) Remove insulating washers and insulating sleeve.

**179. COUNTERBALANCE AND BUFFER**

Remove complete unit by unscrewing buffer bush, separate the various parts on the bench if desired.

The removal of these parts is obvious.

**180. DETAILS OF BREECH MECHANISM LEVER**

Remove

- (1) Rack pinion.
- (2) Cap for releasing check screw.
- (3) Actuating spring with bearing disc.
- (4) Rack. In re-assembling screw in assembling rod in hole provided in pinion of rack to facilitate alignment of keys.
- (5) Axle pin for catch bar actuating lever.
- (6) Catch bar actuating lever.
- (7) Catch bar rod pins by sliding towards handle of B.M. lever. (Remove plunger and spring by withdrawing retaining pin.)
- (8) B.M. lever catch with spring and bearing guide.
- (9) Locking lever nut.
- (10) Locking lever complete. (Remove plunger and spring by unscrewing head.)

**181. DETAILS ON B.M. LEVER STOP BRACKET**

Remove:—

**PREVENTION OF MISFIRING**

184. The following points as regards the routine maintenance of the breech

Page 21 Last line. Delete "185-189" and substitute:—

**BREECH MECHANISM—DRILL PRECAUTIONS.**

185 To avoid damage to parts of the breech mechanism during the following preparations for drill are to be made:—

- (a) Unship the firing case.
- (b) Ease back the cap on the breech mechanism lever to the drill mark on the cap. (This is to be done because otherwise, with the parts named in sub-paragraph (a) above removed, the speed of travel of the breech block would be excessive with consequent damage to the mechanism.)

Note. This limit must not be exceeded.

186 After drill the breech mechanism is always to be stripped down and lubricated. Care must be taken to screw the cap back again to its normal position when re-assembling the gear, in order that the proper tension may be replaced on the spring for service working.

187-189

(G 02178 49 A F O P 371 48)

(Previous amendment No 17 A F O, P 559, 48)

breach in class E. If in class E, the breech mechanism is to be stripped down and lubricated after drilling. The cap is to be screwed back to its normal position when re-assembling the gear, in order that the proper tension may be replaced on the spring for service working.

Page 21

(G 02178 49 A F O P 371 48)



## CH. II. SECTION 3—THE SEMI AUTOMATIC GEAR

## Plate 12, 13

190. Semi-Automatic Gear for full and reduced charge firing is supplied for each gun, and is designed to open the breech automatically during run-out.

191. The **crank arm bracket** is secured to a vertical frame (see 4) on the side of the **cradle**. Its centre portion is of channel section, the webs providing a bearing for the **change-over lever spindle**.

192. The **retaining catch** at the rear end of the change-over lever engages in either of the two positions, Q F or S.A.

193. The **crank arm**, carrying a hardened steel roller at its lower end, rotates on the **change-over lever spindle**. This spindle is formed with a **wind key** which is positioned in a circumferential slot in the crank arm. This slot is designed to permit movement between the crank arm and change-over lever when the former is tripping in semi-automatic action.

194. The upper end of the crank arm is formed as a toe which bears on the top of a spring **plunger**. In the semi-automatic position of the change-over lever the plunger by pressure on the toe holds the underside of the crank arm against a **stop** on the inside of the crank arm bracket (see Plate 14).

195. The actuating parts of the gear consist of a **cam** having two working surfaces, upper and lower, formed upon it. The cam is mounted on a **cam bracket** which is secured to the side of the barrel ring. An **actuating link** connects the cam to the **breech mechanism actuating shaft lever** which operates the **breech mechanism crank**.

## ACTION OF THE SEMI-AUTOMATIC GEAR. Plate 13

196. The action of the cam and the crank arm roller during recoil and run-out is illustrated by the diagrams on this plate. The cam, cam bracket and barrel ring travel bodily with the gun.

## RECOIL

197. When the gun recoils the cam travels bodily to the rear. The upper surface of the cam makes contact with the roller. The latter rides up the sloping surface of the cam and causes the crank arm to rotate clockwise, thus compressing the **plunger spring**. During this action the violent and over run of the plunger spring the **buffer spring** comes into action and absorbs any shock (see Plate 14).

As soon as the cam has passed clear of the roller, the plunger spring returns the crank arm to its normal position.

## RUN-OUT

198. When the gun runs out the lower surface of the cam comes into contact with the roller. As the crank arm is now held against this stop, the cam is forced to rotate clockwise separating the actuating link forward and operates the breech mechanism. The cam continues to rotate until the heel of the cam comes over the top of the roller. The roller slides through the gap in the cam and the breech mechanism is open in the loading position. On the insertion of a new round the breech block chamber and automatically returns the cam to its normal position.

## QUICK-FIRING ACTION

199. When the change-over lever is moved to the quick firing position, the crank arm is rotated anti-clockwise to a position in which the roller is well clear of the path of the cam during recoil and run-out. The breech block has therefore to be opened by hand by the **breech mechanism lever**.

## TO CHANGE REDUCED AND FULL CHARGE SEMI-AUTOMATIC GEAR

200. Withdraw the split pin from the **retaining catch axis pin** and remove both.

201. To connect the **actuating link** from the cam by withdrawing the split pin from the **link axis pin**, and remove the latter.

202. Rotate the **change-over lever** clockwise until arrested by the **stop** on the **crank arm bracket**.

203. Insert the tommy bar through the **finger piece** in the outer web of the bracket and allow the flats on the end of the bar to bear on the top of the **plunger**.

204. Force the tommy bar up and depress the **plunger**, and at the same time withdraw the **change-over lever** inwards. Two men were required to perform this operation.

205. Remove the tommy bar.

206. Withdraw the **crank arm** by partially rotating the **cam** clockwise and opening the **breech mechanism lever** to allow sufficient space for the **crank arm** to pass.

207. Rotate the **cam** clockwise about 135 deg from its normal position swinging the **breech mechanism lever** sufficiently to allow this, and withdraw the **cam**.

208. To replace the alternative gear the operation described should be reversed.

## CAUTION

No account should full charges be fired from a mounting in which reduced charge gear is stopped.

## CHAPTER III

## SECTION 1—THE TRAINING BASE, CENTRE PIVOT AND ROLLERS

## FIG. 1

**LOWER RACER BASE PLATE**

222. The **lower racer base plate** (Fig. 1) consists of a steel casting which is bolted to a steel parking ring and through this to the deck by 28 holding-down bolts of 1½ in. diameter and 18 coarse threaded screws of ¾ in. diameter. On top of the base plate a **roller outer path** is formed, which carries the **training rollers**. The **training rack** is bolted to the base plate inside the roller path. A projection on the outside of the lower roller path is machined to provide a facing for the **training clips**. These clips prevent the mounting from lifting when the guns fire.

223. The spaces outside the roller path and between the roller path and the training rack are drained through machined into a **drain groove** cut on the underside of the base plate and thence to the centre of the mounting through the hole above between the parking ring and the base plate (Fig. 3). Water collects in a **drain sump** under the centre of the mounting and is drained from here through a pipe to a scupper.

224. A large boss is formed in the centre of the base plate into which fits the outer race of the **centre pivot roller bearing**.

**TOP RACER CARRIAGE PLATE**

225. The **top racer carriage plate** consists of a steel casting to which the carriage is bolted. The upper roller path is formed on the underside of the carriage plate. Two gaps are cut in the upper roller path to allow the rollers to be removed for examination (Fig. 4).

**CENTRE PIVOT**

226. The **centre pivot** (Fig. 2) is pigoted into the carriage plate and extends downwards from the centre of the carriage plate through a hole in the base plate. A roller bearing is fitted between the centre pivot and the base plate and takes the lateral thrust on the mounting when the guns are trained. The centre pivot is hollow and the electric cables and the ventpipe are led up through it to the mounting.

**THE CLIPS**

227. The clips are bolted to the carriage plate and prevent the mounting from lifting when the guns fire by bearing against the underside of the lower roller path. There are three clips on each side of the train and one short clip at the rear. The correct clearance is 0.01 in. Light cover plates between the clips prevent dirt from getting on to the roller path.

**TRAINING ROLLERS**

228. The **rollers** (Fig. 3 and Fig. 4) of which there are 36 are made of stainless steel. They are slightly tapered at each end and have flat ends at both ends. The roller is at right angles to the axis of the train. The pins are screw threaded. **Five roller rings** are connected in pairs by **links** which fit over the hexagon heads of the pins and are secured by split pins.

**LUBRICATION**

229. Oil grooves are cut round the roller axis pins for lubrication of the rollers and pins. The oil is fed from two **lubricators** in the carriage plate and passes into a channel cut in the top of the roller ring. Oil holes are drilled in the five roller ring to feed the oil to each roller.

**STRIPPING****TO REMOVE THE CENTRE PIVOT ROLLERS**

230. Four tapped holes are provided in the top of the centre pivot in which **locking screws** can be inserted to remove the roller rings for examination.

The four tapped holes are normally plugged with preserving screws. Before forcing down on the roller ring the **retaining ring** at the underside of the roller race must be removed. A hole is cut in the deck and the central plate of the drain sump under the mounting is portable for the removal of the rollers and cage.

**TO REMOVE A TRAINING ROLLER (FIG. 4)**

231. Two **gaps** are cut in the upper roller path to allow the rollers to be removed for examination. These gaps are situated one on each side of the mounting near to the centre line. Remove the four cover plates over the gaps in the upper roller path. Train the mounting till one of the gaps is over the roller to be removed. Remove the link and unscrew the axis pin from the five roller ring. Then lift up the roller till the flanges clear the lower roller path and withdraw the roller.

## CH. III. SECTION 2—THE CRADLE, RECOIL, AND RUN-OUT ARRANGEMENTS

### Plate 17

238. The cradle consists of a complete steel casting which carries both guns and into which are screwed and shrunk securely into place the two forged steel trunnion pins.

239. Secured to the underside of the cradle by fitted bolts is the elevating arc of forged steel.

240. Four bronze rings are riveted into either end of the cradle on which the gun bears during recoil and run-out. Special grease distributors are fitted to force grease in between these rings and the gun.

241. The balance ring carries the recoil cylinder, control rod and compensating tank.

242. The piston rod of the recoil cylinder is secured to a lug on the cradle by two nuts.

243. The recuperator cylinder is secured to the cradle, and the recuperator ram is secured to the balance ring by two tie rods and a crosshead.

244. The intensifier is mounted on the cradle and is arranged with air charging connection and valve, pump charging adaptor and hose for pressure gauge.

245. The recoiling portion of the interceptor is secured to the balance ring the non-recoiling portion or falling contact box being fitted to the S.A. crank arm bracket on the cradle.

Page 25 paragraph 246. Add: When balance rings are fitted to guns, care must be taken that the surfaces where the balance ring overlaps the breech ring are well served with thick graptated grease. Otherwise rust will occur and the breech ring may be difficult to remove when the barrel requires exchange."

(G. 00899:43. A.F.O. P. 8, 46.)

248. Flats are machined on either side of this cylinder and two bronze bearing plates secured in the balance ring take against these flats.

Thus the balance ring and hence the gun is prevented from turning in the cradle on firing.

249. The recoil piston rod is arranged with a small clearance in the lug on the cradle to which it is secured so allowing for wear of the bearing surfaces in the cradle and for the tendency of the gun to twist without the strain being taken by the sides of the piston rod against the glands of the recoil cylinder.

250. The guns and cradle with all details, including recoil liquid, etc., in place, are carefully balanced about the trunnions by adjusting lead weights which are carried in pockets in the balance ring.

Note.—When balancing, both guns are to be loaded.

### INTERSEPTOR

251. The intensifier consists of a cylinder in which travels a piston and piston rod.

An indicator at the rear of the intensifier shows whether the intensifier is "Full" or "Empty."

### ACTION OF THE INTERSEPTOR

252. A pipe carries the air pressure from recuperator to the front of the intensifier. The initial pressure being 470 lbs per square inch. The rear end of the intensifier cylinder is full of liquid and is connected by a pipe liquid to recuperator gland to the inside of the "U" leathers of the recuperator gland.

253. The effective area on the front side of the piston is greater than the other side by the area of the rod, and the liquid is consequently forced into the recuperator gland at a higher pressure than that of the air in the recuperator, thus keeping the "U" leathers tight in the recuperator.

254. As the air pressure in the recuperator rises during the recoil of the gun so does the intensifier correspondingly increase the pressure of the liquid on the recuperator "U" leathers.

255. The piston is kept tight by "U" leathers and the piston rod by a "U" leather and packing.

### FILLING THE INTERSEPTOR WITH LIQUID

256. Before charging the intensifier with liquid for the first time or after re-assembly, the indicator should be set at "Empty" to ensure that there is as little air as possible on the liquid side of the intensifier system.

257. Detach plug from charging inlet "B," connect charging pump to charging inlet, open valve "A" and pump until indicator indicates "Full."

258. Close valve "A" and detach pump and replace plug in the charging inlet.

259. Composition of Liquid Mixture.—1 part potash soft soap to 2 parts of heavy torpoyl about 3.4 pints of mixture is required.



### CHARGING THE RECUPERATOR AND INTENSIFIER WITH AIR

260 The recuperator is charged with air through the intensifier from the ship's H.P. air supply. An instruction plate is fitted to the mounting.

Lay the gun horizontally, and screw the pressure gauge into the connection engraved "G".

Detach the cap nut on the air charging connection engraved "F" and attach the flexible air charging hose.

Open the air charging stop valve engraved "H" and charge with air to a pressure of 970 lbs. sq. in. Close the valve "F" and detach the flexible hose and the pressure gauge and replace the cap nut on the adaptor "E".

A drain valve is provided at the rear end of the recuperator which may be opened to adjust the air pressure in the recuperator.

The recuperator drain valve should be opened periodically to ensure that no intensifier liquid or water is drawn inside the recuperator cylinder.

### STRIPPING INSTRUCTIONS FOR RECUPERATOR

#### 261 1. TO REPACK RECUPERATOR CYLINDER GLAND

(1) Put the gun to depression.

(2) Release the air pressure by opening the drain valve.

(3) Withdraw the ram securing nut split pin and remove the ram securing nut.

(4) Remove the stop key, tie rod from securing nuts and split pins, and crosshead. Space is now available to repack the gland in the usual manner.

#### 262 II. TO REMOVE RECUPERATOR RAM AND CYLINDER SEPARATELY

(1) Proceeding from 1, remove the gland packings. Withdraw the recuperator ram forward.

(2) Remove the pipe adaptor to the cylinder, the cylinder securing nut and locking plate, the glander locating screw and the drain valve.

(3) Withdraw the recuperator cylinder forward out of the balance weight.

#### 263 III. TO REMOVE RECUPERATOR RAM AND CYLINDER TOGETHER

(1) Proceeding from 1, remove the recuperator cylinder as described in II, withdrawing the whole unit forward without unpacking the gland.

### THE RECOIL CYLINDER. (Plate 18)

264 The energy of the recoil of the gun is absorbed mainly by the recoil cylinder and piston but partly also by the compression of the air in the recuperator cylinder.

265 The recoil cylinder is rigidly secured in the underside of the balance ring by a shoulder at the rear end and a nut at the front end, within the cylinder is the hollow piston rod and piston into which is screwed the recoil control ring.

266 The front end of the piston rod is secured by nuts to a lug in the cradle. It is not a close fit in the lug and this permits the rod to "drop" the very small amount required to allow for "drop" of the gun, due to wear of the bearing rings in the cradle.

267 Within the hollow piston rod fits the control rod which is secured at its rear end by a nut and therefore moves in recoil with the gun.

### ACTION DURING RECOIL

268 When the gun recoils the cylinder and control rod are carried to the rear with the gun, the piston and piston rod remaining fixed.

269 As the cylinder travels to the rear the liquid in it is forced through the ports in the piston head, through the annular space (C) between the recoil control ring and the control rod to the rear of the cylinder.

270 This annular space becomes gradually smaller during the recoil because the control rod is tapered, having its maximum diameter at the front end.

271 The shape of the taper is designed so that the retarding effect is approximately uniform throughout the length of recoil.

272 The pressure set up in the cylinder also forces a certain amount of liquid into the space between the piston rod and the control rod.

273 The front end of the control rod is fitted with a control shuttle valve, the travel of which is limited by the retaining nut screwed to the control rod.

274 During recoil the control shuttle valve is forced by pressure of liquid towards the front, thereby allowing liquid to pass through the ports (A) into the increasing space (B) which at the end of recoil will be completely filled.

### ACTION DURING RUN-OUT

275 On completion of recoil the gun is returned to the firing position by the pressure of air in the recuperator cylinder. The speed of run-out is governed by three control grooves which are cut

in the inside wall of the piston rod. These grooves are of varying cross-sectional area and are largest at the rear end, gradually diminishing in depth towards the front.

274. When the run-out commences, the control rod begins to travel to the front. Sufficient pressure is now set up in the space (B) to force the control shuttle valve hard over to the rear thus completely closing the ports (A).

Note: The pressure of liquid from the space (B) is over the control

- Note: In future when wear is found to have occurred in the bore of the recoil piston rods (Item 1 of drawing N 5173; the worn piston rod is to have the bore ground true and an oversize shuttle valve (Items 6 and 7 of drawing N 5173) fitted. On no account should the bore of the recoil piston rod be increased above 2.560 in. + 0.02 in.)

The words OVSERIZE BORE followed by the new diameter, are to be stamped on the face of the piston rod.

The final diameter of the shuttle valve + 1/32 in. give a diametric clearance of not less than .002 in. and not more than .004 in. at the new bore. The word OVSERIZE followed by the new diameter is to be stamped around the 2.14 in. diameter portion of the valve. A small brass plate engraved OVSERIZE SHUTTLE VALVE FITTED is to be attached to the end of the control rod so as to be visible when recoil cylinder is assembled.

When oversize shuttle valves are fitted, a report is to be forwarded to the Director of Naval Ordnance Administration 14a by posting the Register Number of the mounting, whether for right or left-hand gun, the new diameter of the shuttle valve and the piston rod bore.

Oversize on the valves 2.560 in. diameter should be demanded from Naval Ordnance Department (Q Section) as required.

Final machining to the required size is to be carried out by the refitting authorities.

One spare shuttle valve, machined to the new diameter, will be supplied for each oversize valve fitted for retention of spare parts.

The report mentioned in sub-paragraph 4 of this note should include remarks concerning behaviour of the gun concerned during run-out and of the action of the S.A. gear.

(Amendment No. 87)

settings.

The recoil system should be carefully filled as air trapped in the system will result in excessive recoil and fierce run-out, which may cause damage to the S.A. Gear.

## TO FILL THE RECOIL CYLINDER

281. An instruction plate is fitted to the mounting

1. Lay the gun in 45 deg. elevation.
2. Remove the down plug (x) and move the air escape plug in and to.
3. Remove the down plug (y) and pour oil from the compensating tank and pour in the liquid until it runs out of the hole for air escape plug (x).

Note: To ensure that all air is expelled from the system, the mounting should then be worked from full depression to full elevation several times and, between each operation, should be vented at 45 deg. elevation through plugs (x) and (y). From time to time during this operation, the gun should be raised back, eased out, and vented in the run out position.

(Amendment No. 88.)

Page 27 After paragraph 281 9<sup>th</sup> as amended by A.F.O. 221 42) add note as follows:

Note: Oil O.M. 13 must be used instead of glycerine and water in recoil cylinders which have been fitted with modified control ring in accordance with Modification No. 85.

(C. 04480 50 A.F.O. P. 8 51)

are arranged for the pressure to expand the "U" leather during recoil.

283. The rear end of the cylinder is closed by the seating arranged on the collar of the control rod which is forced home on to a copper joint ring by means of the retaining nut which screws into the cylinder.

The section of the copper ring is such that it is expanded readily by the pressure of the nut thereby ensuring an effective seal.

284. A stop key is fitted in the cradle just clear of the run-out crosshead when the gun is in the fully run-out position. Its object is to allow the recoil cylinder gun to be re-packed without releasing the pressure in the recuperator cylinder. This can be done by unscrewing the retaining nut from the key on top of the ram on the cradle then easing back the long nuts on the rear ends of the crosshead tie rods and slightly elevating the gun.

285. The gun will run back under its own weight the recuperator ram being retained in position by the stop key.

The tie rods are long enough to allow the gun to be run back as far as is necessary for the glands at the front end of the recoil cylinder to be re-packed. The long nuts on the tie rods can be turned back fifty-four turns with safety.

286. After re-packing, the gun must be run-out by means of the long nuts on the tie rods. It is essential that the long nuts be screwed hard up to ensure the plan clearance between the crosshead and the stop key.

### **RUN-OUT ARRANGEMENT**

287. The gun is run-out by compressed air, and the arrangement of the recuperator is shown on plate

The recuperator cylinder above the gun is rigidly secured to the cradle and does not move as the gun recoils or runs out.

Within the cylinder works a hollow ram which is secured by a nut to the crosshead.

Two tie rods connect the crosshead to the balance ring on the gun and thus the movement of the gun during recoil is imparted to the hollow ram.

A machined surface is provided on top of the cradle to act as a guide for the crosshead.

The recuperator cylinder is connected by a pipe to the intensifier. (Plate 17)

The cylinder can be charged through a flexible hose fitted to a connection arranged on the front of the intensifier.

The recuperator cylinder should be charged to 970 lbs. per square inch.

### **ACTION OF RUN-OUT CYLINDER**

288. When the gun recoils, the ram is carried to the rear into the recuperator cylinder, further compressing the air therein. This increase of pressure assists the recoil system to bring the gun to rest.

When the recoil of the gun is overcome the pressure in the recuperator cylinder asserts itself and forces the ram to the front, so returning the gun to the firing position.

The gland of the recuperator cylinder is formed by two "U" leathers between which liquid is forced, at a greater pressure than the air inside the cylinder by the intensifier which is connected direct to the liquid gland at the front end of the cylinder.

Outside the "U" leather gland is another gland of cotton packing.

## **STRIPPING**

### **289. I. TO REPLACE RECOIL PISTON GLAND**

- (1) Drain the recoil cylinder by opening the drain valve.
- (2) Remove the piston rod split pin and nut.
- (3) Ease back the long nuts on the rear ends of the recuperator tie rods, and slightly elevate the gun. The gun will run back under its own weight, withdrawing the piston rod end out of the lug on the cradle.
- (4) Remove the piston rod collar locking screw, and piston rod collar.
- (5) Space is now available for repacking the piston gland in the usual manner.

### **II. TO REMOVE THE CONTROL ROD AND RECOIL PISTON COMPLETE**

- (1) Remove the breech mechanism to obtain access to the control rod retaining nut, then proceeding from (I), remove the gland packings.
- (2) Remove the retaining nut for the control rod.
- (3) Withdraw the control rod and recoil piston to the bench.

### **III. TO REMOVE THE CONTROL ROD AND SHUTTLE VALVE**

- (1) Withdraw the control rod out of the piston rod to allow of access to the recoil control ring.
- (2) Remove the recoil control ring locking plate by withdrawing the split pin and securing nut. Withdraw the control rod together with the control ring for examination of the shuttle valve.

### **IV. TO REMOVE THE RECOIL CYLINDER COMPLETE**

- (1) Remove drain plug and drain the recoil cylinder.
- (2) Remove the filling adaptor in bottom of recoil cylinder at rear, piston rod nut, air valve "Z," cylinder securing nut locking bolt, and cylinder securing nut.
- (3) Withdraw cylinder complete from balance ring.



## CH. II SECTION 3--THE TRUNNIONS

## Plate 1B

296 The trunnion brackets are cast and are properly fitted and keyed to the turning plates provided on the top of the carriage side plates.

A phosphor-bronze spherical bearing is also assembled in the trunnion pin and is secured in position by the trunnion keep. A dove pin is secured in the trunnion keep of the trunnion bearing revolving.

In order to reduce elevating efforts a ball thrust bearing is interposed between the thrust face of the spherical bearing and the collar of the trunnion pin and a self-aligning roller journal bearing is fitted on the end of the trunnion pin.

The roller bearing is secured in position by a nut and a lock washer, comprising a support for the ball thrust bearing with an adjusting washer and a pair of Belleville washers.

The load on the Belleville washers is regulated by means of an adjusting screw which is secured by a lock washer and a lock nut consisting of an adjusting screw and adjusting screw bush.

To apply the load, one full turn down of the screw (0.007-in. so that a very fine adjustment can be obtained).

The correct position of the bush is determined by a groove in the collar which must coincide with the groove in the adjusting screw bush. An indicator plate is secured to the trunnion bracket. The adjusting screw bush is secured by means of a locking bolt, which when engaged in a slot formed in the collar of the screw.

When the adjusting screw is raised to the adjusted position, the weight of the elevating mass is transmitted through the spherical bearing to the roller bearing and the elevating effort is reduced to a minimum.

On firing the Belleville washers yield, and the firing shock is transmitted through the spherical bearing to the carriage.

A locking plate is secured to the trunnion bracket which when engaged in the groove of the adjusting screw bush, secures the trunnion bracket in position in the roller journal bearing and in position of the anti-friction gear.

An elevation indicator is attached to the end of the trunnion pin to be left hand and right hand illuminated by means of the electric lamp provided.

297 Note: Power in service has shown that the design of the carriage side plates is not correct. The spread of the carriage sides away from the center of the mounting is not correct. The amount of the cradle.

The earlier deficiencies are therefore being corrected by substituting the present design of the carriage side plates and the trunnion pins.

## ADJUSTMENT OF LOAD ON BELLEVILLE WASHERS

298. The following method should be adopted for assembling and adjusting the Belleville Washers and adjusting screw assemblies:-

a) Set the adjusting screw of the adjusting screw bush so that there is 0.5 in. gap between the under side of the collar of the former and the top of the latter.

b) Screw these assembled items into the trunnion bracket until the groove on the collar of the adjusting screw bush coincides with the ASSEMBLY index line on indicator plate R.H. or L.H.

(c) Lock the adjusting screw with the locking bolt.

Page 29 (as inserted by A.F.O. P. 526.51) after paragraph 297 (as inserted by A.F.O. P. 526.51)

298A. Due to wear hammering and other causes the method of adjustment described above does not give the same clearance between trunnion and trunnion brass at all instances. Neither does it always result in the correct clearance being set.

To obtain the correct clearance the adjusting screw bush should be screwed in the direction of the arrow until the hand elevating efforts drop to a suitable near minimum value.

A check may be made by means of a clock gauge secured to one of the cap square bolts. To observe the actual movement of the trunnion pin which should be approximately 0.007 in.

(G. 1920 53--Amendment No. 25.)

## INSTRUCTION FOR REPAIR OF CORRODED TRUNNION PINS

299 The trunnion pins should be machined to clean up the pin for a distance about the pin 3-in. and new brass made an effort to get the new diameter. The maximum diameter which a pin may be reduced before renewal is necessary is 4.5-in. Both pins should be machined to the same diameter. The amount of metal removed should be the minimum required to clean up the pin.

The new diameter should be clearly stamped on the brass and in a convenient position on the trunnion pin.

29A

for this work does not affect the efficiency of the mounting. If the bearing should be examined.

In view of the above remarks and the work involved in machining the trunnion and other parts, serious proportions.

When the gun is hauled back, the weight of the gun is supported by the trunnion and the bearing.

When the gun is hauled back, the weight of the gun is supported by the trunnion and the bearing.

300

### SECTION 3. THE HAULING BACK GEAR

#### Plate 20

301. No deck fittings are required for this type of hauling-back gear and slip tests should be carried out on the gun.

302. The gun is hauled back by the use of the hauling-back gear which is mounted on the rear links. The gun is hauled back by the bottle screw and slip hook.

For guns with parallel muzzles an adaptor bush must be used, or the muzzle cap must be securely fastened.

303. The following precautions are always to be taken before a Slip Test is carried out :-

(a) At R.P.C. mountings all clutches are to be in "hand" and the mounting moved by hand only.

(b) A hard wood chock of sufficient height to leave the guns approximately horizontal is to be provided between the baseplate and the balance weight of the gun which is not to be moved.

(c) The guns are to be elevated to ensure the chock is gripped and the handles are to be securely lashed in that position.

(d) Should it ever be necessary to slip test both guns in a mounting at the same time, subject

to the following precautions :-  
The guns are to be hauled back by the use of the hauling-back gear which is mounted on the rear links. The gun is hauled back by the bottle screw and slip hook.

Note : When slip testing one gun only, the precautions outlined in (d) above may be used in addition.

304. No one is ever to go or work beneath the cradle during the Slip Test operation.

#### TO SLIP TEST THE GUN

305. Before using the gear to haul back, adjust the support rope to take the weight of the gun and the mounting. Haul the gun back by operating the catchet lever.

306. Before slipping the gun by releasing the slip hook, the portable handle should be removed.

307. The catchet is double-acting and can be reversed to run-out the gun in slow action if required.

308-310

(G. 07482-51—A.F.O. P.526,51)

## Plate 79

A phosphor-bronze spherical bearing in halves is assembled on the trunnion pin with the aid of a pin and a trunnion keep. A cover nut secures the trunnion key. The bearing is secured by a bearing cap.

In order to reduce elevating efforts a ball thrust bearing is interposed between the inner face of the spherical bearing and the collar of the trunnion pin, and a self-aligning roller journal bearing is fitted on the end of the trunnion pin.

## 14 ۛۛۛۛۛۛۛۛ

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- 144 1000

new to the area and was working on the Bellvue Washers.

(The stripping instructions are indicated on Plate 19)

1. position

Bellevue Washers are replaced complete 'make' sets of Bellevue washers and associated parts as required as they wear on the set of spurs.

only, and

(G. 442E/47 — A F.O. P 388/47)

of the carriage part of the

The same Rules apply to all other cases of copy which is delivered provided with, and made up together, through the

down on date 199

When the gun is mounted, the gunner should leave the gun approximately 10 feet behind the baseplate and the balance weight if the gun will be not firing. Care is to be taken to avoid damage to the baseplate and the stoppage tank situated below the balance weight.

215b/54

... the whole is grouped and the hundred  
... the whole is grouped and the hundred  
... the whole is grouped and the hundred

Add to paragraph 102 as amended by A J O F 415 44) —

When the gun is fired, the muzzle flash must be used, or the muzzle cap must be removed to prevent the muzzle cap from flying off when the gun is fired.

• stop place to animals built. Flat bar or Angle bar cut away in

in a gun only the provisions set forth in (a) above  
those prescribed in (a), (b), and (c) if desired and are  
to ship.

and a few weeks before the arrival of the ship, the

1

Ch. 11

4. If the gear to hold back, adjust the support rope to make the

as shown on the plate. Set the lever of the semi-automatic




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ALL RIGHTS RESERVED. REPRODUCTION BY ANY MEANS WITHOUT PERMISSION IS PROHIBITED.

[illegible]

ii)  $\beta \in \Gamma^{(1)}$

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the magazine cap must be attached to  
it when the cap is put on.

10. I am a superior being to like  
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because I am a superior being

~~stable handle should be removed~~

be kept in slow motion

10.  $\frac{1}{2} \log \frac{1}{2}$



## CHAPTER IV

### SECTION 1. ELEVATING GEAR

#### Plate 21

311. The elevating gear is operated from the left hand side of the mounting by means of two handles attached to crank arms which are carried by a support bracket fixed to the carriage.

312. A ball race is fitted in a cap at the top of the support bracket and forms the bearing for the crank arm shaft.

313. The drive from the handles turns a bevel wheel and bevel pinion, the latter being keyed to the worm shaft and thence through the worm and wormwheel which actuates the elevating pinion shaft and elevating pinion.

314. The layer is provided with an adjustable ~~nut~~ and adjustable foot rest secured to the platform.

315. The elevating receiver is situated in front and slightly towards his left.

The forward or clockwise movement of the handles elevates the guns, one complete turn of the handles elevates the guns through 3 deg.

316-320.

#### ELEVATING GEAR—ARRANGEMENT OF WORM DRIVE AND PINION. (Plate 22)

321. The elevating pinion is arranged on the fore and aft centre line of the carriage and is driven by a worm shaft through a worm, wormwheel and friction discs.

322. The worm shaft is operated by the elevating handles through a pair of bevel wheels, from the left-hand side of the carriage.

323. The pinion is supported by a bracket which is fitted and keyed to the facing on the elevating structure between the carriage sides.

324. The pinion shaft is provided with roller bearings arranged in the pinion bracket and a ball bearing in the wormwheel bracket.

325. The wormwheel bracket is spigoted into an inner facing and the side plate of the carriage and is secured by bolts.

326. In order to ensure that the wormwheel bracket is a good fit between the inner facing on the carriage and the facing on the elevating box girder structure, a tapered piece is fitted between the latter facing and the base of the bracket.

327. The cover for the wormwheel bracket is spigoted into an outer facing and the carriage side plate.

328. The worm runs in an oil bath and an oil level plug and drain plug are provided in the cover.

329. A double thrust bearing is fitted on the worm shaft to take the axial thrust in either direction and ball bearings are fitted to support the worm.

330. Instructions for assembling the Belleville washers are given on the plate.

### STRIPPING

331. **REMOVAL OF WORM.** (1) Drain the oil from wormwheel bracket or oil and remove its return.

(2) Remove the bevel gear box cap.

(3) Remove the wormshaft spl. pin securing nut and pinion.

(4) Remove the bevel gear box and bearing.

(5) Remove the nut and check nut securing the thrust bearing, and remove the thrust bearing from the shaft.

(6) Remove the end cover for the wormwheel bracket.

(7) Withdraw the wormshaft and remove the worm and worm bearings.

332. **REMOVAL OF ELEVATING SHAFT AND PINION.** After the removal of the worm. (1) Remove the pinion shaft inner bearing, securing cap, locking plate, and cap.

(2) Remove the inner bearing shaft nut and check nut after taking the necessary precaution to prevent the elevating pinion being rotated while these nuts are slackened back.

(3) Remove the pinion shaft outer bearing, securing nuts, and locking plates, and slack back nuts on shaft.

(4) Similarly remove the locking plates and securing nuts in the way of the bearing in the elevating wormwheel bracket. Withdraw the elevating pinion shaft complete with wormwheel, Belleville and friction washers, etc.

(5) Remove the elevating pinion and elevating pinion shaft bearings.

### LUBRICATION

333. The wormwheel is lubricated by means of a Rotherham's lubricator fitted in the top of the wormwheel bracket while lubrication is provided to all ball and roller races by Enot's lubricators.

### GUN LAVER'S FIRING GEAR

334. The drive from the handism is through a bevel wheel and bevel wheel pinion to the elevating worm shaft.

335. The trigger is connected by a pair of links to a slip ring (arranged in the firing handle) which engages with the actuating firing lever.

336. This lever operates the firing switch by means of a push rod passing through the centre of the bevel wheel shaft. The firing gear is brought back to the normal position by the action of the return spring.

337. The end of the actuating firing lever is fitted with an adjustable stopper to regulate the movement of the push rod.

338. The guns can be fired by the trigger through either the main or auxiliary firing circuits.

### LUBRICATION

339. Lubrication is provided to all ball races by Enot's lubricators, three Springwell oil cups are also fitted and an oil hole arranged in the firing handle.

### STRIPPING

340. (1) Remove the split pin securing the inner crank handle lever through the bevel wheel driving shaft. Disconnect the support bracket cap, together with the shaft, crank handles and trigger firing gear complete.

(2) Remove the firing switch box.

(3) Remove the outer bevel gear box cover, together with driving shaft, bevel wheel, bearings, etc. complete.

341-343.

## (H. IV. SECTION 2—SAFETY FIRING GEAR

345. The gear is designed to ensure that the interceptors are broken or cannot be made between the limits of 20 deg elevation and 0 deg depression when the mounting is trained into a danger zone. This gear is operated by a vertical cam rail secured to the deck.

347. The gear is in two portions, the lower arranged on the right-hand side of the mounting and the upper attached to the cradle.

348. In the lower portion a spring box is secured to the channel beam which supports the platform. The channel beam is fixed to the front of the mounting. A sliding rod, operating through the spring box, carries the cam roller which moves around the vertical cam rail when the mounting trains. The compression spring in the box maintains the roller on the cam rail.

349. The vertical movement of the sliding rod is transferred through a series of levers to a sliding cam fitted in a guide bracket attached to the inside of the right-hand trunnion bracket.

350. The upper portion of the gear is supported on the cradle by small brackets.

351. The bracket supporting the bell crank lever carrying the roller which is actuated by the sliding cam is fitted on the right-hand side of the cradle only.

352. Another bell crank lever supported by the same bracket, unparts the travel to the rods which break the interceptors on the right and left-hand sides of the cradle.

353. An adjustable spring is provided for returning the gear on the cradle when a safe area is reached, this spring is arranged in a spring bar on the right-hand side only.

354. The spring is to be adjusted so that the compression of the spring is just sufficient to return the gear on the cradle.

### ADJUSTMENT OF SAFETY FIRING GEAR

355. The lower portion of the safety firing gear—that is, the system of levers operated by the deck cam and controlling the sliding cam—are not adjustable. The movement of the levers is controlled by the contour of the deck cam.

The maximum travel of the various levers necessary to operate the safety firing gear at its limit of 20 deg elevation of the mounting is shown on the Plate.

356. The upper portion of the safety firing gear secured to the cradle is provided with adjusting nuts to obtain the exact travel required. These nuts should be adjusted so that the upper roller is

moved 0.6-in. by the movement of the sliding cam. With the same adjustment the collars of the horizontal rods should be in contact with the stop faces on the brackets when the roller and sliding cam are disengaged.

357 (3) In the safe position the horizontal push rods operating the interceptors should be 2.9-in. from the bearing face of the balance ring. When the mounting enters a danger area the horizontal push rods will move 0.4-in. The clearance between the end of the push rod and the interceptor in the safe position is .05-in. When these adjustments have been made, it should be checked that interceptors open some 2-3° before the danger angle.

357 (4) **Warning.** Failure of the safety firing gear to operate correctly may be due to

(a) Lack of adjustment—this is measurable

(b) Lack of maintenance—this is also measurable—very thorough lubrication and maintenance is necessary

**Note.** Examination of the safety firing gear to ensure that the interceptors cannot be made in the danger angles should be carried out daily.

## THE SAFETY FIRING SWITCH AND OPERATING GEAR

### Plate 34A

#### Introduction

357 (2) The original safety firing gear prevented firing on the danger zone when the guns were at any angle between 10° depression and 20° elevation. At angles of elevation above 20° the gear was ineffective. The safety firing switch and its operating gear was designed to prevent firing up to any bearing angle between 10° depression and 80° elevation, when the guns are in a dangerous bearing. The principal difference between these two types of safety firing gear is as follows—

With the original type, the firing circuits were broken on reaching the danger zone, by the automatic opening of the interceptors which were mechanically operated through a system of rods and levers extending on the mounting by means of a vertical cam rail fixed to the deck.

The firing switch, however, breaks the firing circuits for both guns and is in addition to and independent of, the interceptors.

357 (3) The safety firing switch is operated by a floating lever, the movement of which is controlled by two separate systems of linkage. One end of the floating lever is connected to the right trunnion pin, whilst the other end is connected to a vertical spring loaded plunger situated between the platforms at the front of the mounting. The lower end of this plunger is connected to a roller arm carrying a cam roller, which comes into contact with a fixed vertical cam rail whenever the mounting trains on to a dangerous bearing.

The profile and extent of the cam rail is obviously dependent upon the position occupied by the mounting on the ship in relation to the various obstructions, and is designed so installation to permit the maximum field of fire commensurate with safety and blast restrictions.

357 (4) The plate shows an isometric arrangement of the operating gear with the safety firing switch in position, an inset of a section through the switch and a further inset of a section through the guide bracket and the spring loaded plunger.

An indicator showing whether the contacts are made or broken is fitted close to the breech worker of the right gun. The indicator is operated from one of the trunnion pins of the safety firing switch.

#### DETAILED DESCRIPTION

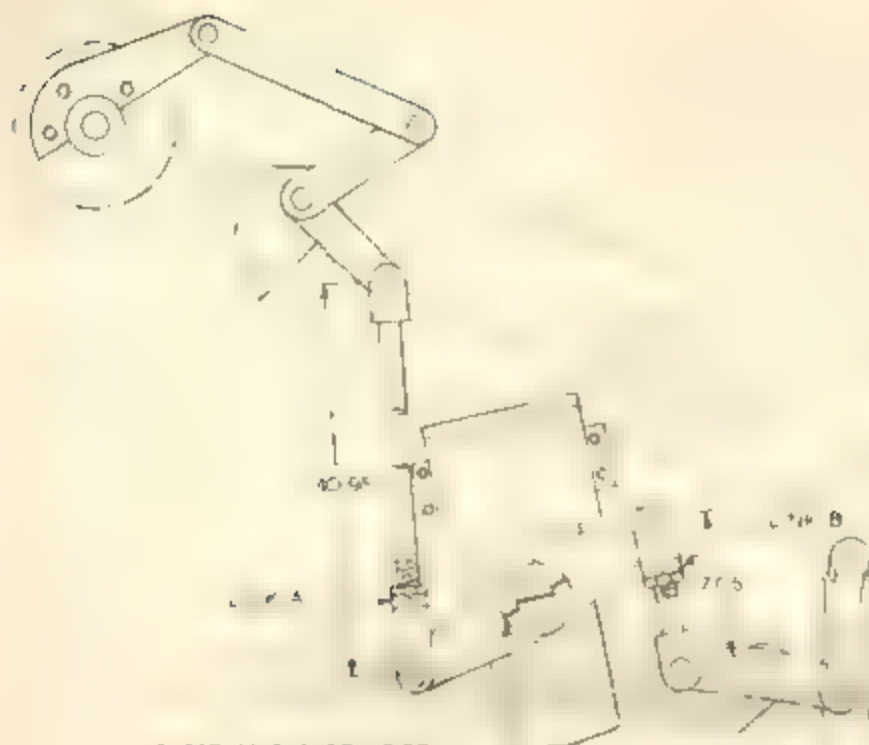
##### The Safety Firing Switch

357 (5) The switch consists of a bracket to the lower end of which is fixed a guide tube. A sleeve closed at one end slides on the guide tube and is prevented from turning by a key which engages with a slot in the guide tube. The closed end of the sleeve is bored to receive the lower end of a plunger which is secured to the sleeve by a nut and split pin. A leather boot at the plunger in the sleeve out of the recess of the leather permits the plunger to be raised through 40° to clear the contact segments, when required. The sleeve and plunger therefore move as one unit. The upper end of the plunger is in the form of a piston with an outer bush which is a hollow inside the guide tube. Two trunnion pins are fixed, one on either side of the sleeve, and the floating lever which is made in two parts in the form of a bridge is bolted together so that the keys between the two portions and the complete floating lever pivots about its middle point on the trunnion pins on the sleeve. An upper or bearing bracket covers the upper part of the sleeve which at its rear is split, fixed and so forms a weather shield. The ends of the floating lever are connected to the linkage systems as shown in the arrangement.

357 (6) The bracket forms a chamber at the upper end of the guide tube within which are carried the four terminals. The terminals are arranged in two pairs, one terminal of each pair being connected to the firing circuit C O S and the other terminals are connected, one to the right and one to the left interceptor.

The top face of the piston on the upper end of the plunger carries two contact segments insulated from each other and from the plunger. When the plunger and sleeve are at the top of their travel, the contact segments connect the two terminals of each pair and the firing circuits to both guns are then complete.





THESE MARKS COINCIDE  
WHEN FLOATING LEVER IS  
AT RIGHT ANGLES TO CENTRE  
LINE OF SAFETY FIRING SWITCH

#### INSTRUCTIONS FOR SETTING LINKAGE

- (i) ADJUST LINKS "A" and "B" APPROXIMATELY TO DIMENSIONS SHOWN
- (ii) ELEVATE GUN TO 20° AND ADJUST LINK "A" SO THAT FLOATING LEVER IS AT RIGHT ANGLES TO CENTRE LINE OF SAFETY FIRING SWITCH & MARKS A FLUORIN LEVER ROSE AND FILCRUM COINCIDENT
- (iii) ADJUST LINK "B" SO THAT ROLLER (WHEN NOT IN CONTACT WITH CAM RAIL) IS APPROXIMATELY 3.58 INS ABOVE BASE OF MOUNTING (DIMENSION "Y")
- (iv) DEPRESS GUN TO 10° DEPRESSION AND ADJUST LINK "A" SO THAT ROLLER (WHEN NOT IN CONTACT WITH CAM RAIL) IS 85 INS ABOVE BASE OF MOUNTING (DIMENSION "X")



#### ADJUSTMENT OF THE SAFETY FIRING GEAR

See also Plate 24 A

An anti-backlash spring is incorporated in the lower end of the guide tube to ensure that the contacts will break in the event of a pin shearing, or any other part of the gear becoming unconstrained through damage.

#### The Spring-Loaded Plunger

357 (7) The cam roller is carried in one end of the roller arm. The other end of this arm is supported by a pivot fixed to the mounting. The spring-loaded plunger is connected to the roller arm by a link. This arrangement is necessary to relieve the plunger of the side thrusts which it would otherwise have to withstand whenever the roller struck the inclined face of the cam rail.

The guide bracket which carries the spring-loaded plunger is fixed to the mounting. Within the guide bracket are the two springs which tend to keep the roller in contact with the cam rail. When the roller is not on the cam rail, the springs force the plunger down until the weather protection cover comes into contact with the top of the spring retaining cap.

#### Operation.

357 (8) The gear is as shown when the guns are at maximum depression and the mounting is trained on a safe bearing. The gun is adjusted in this position so that the circuits through the switch are made. This adjustment is made at the adjustable double eye at the lower end of the long rod in the elevation system.

If the guns are elevated while the mounting remains on this bearing, the left-hand end of the floating lever is raised and the floating lever pivots about its centre, raising its right-hand end to break the circuits, thereby raising the spring-loaded plunger, compressing the springs and so constraining the floating lever to keep the circuits made. Alternatively, if the guns remain at maximum depression and the mounting be trained on the dangerous bearing, the cam roller will move up to the first step of the cam rail. As the cam roller enters the slope of the first step, the spring-loaded plunger is raised and this motion causes the right-hand end of the floating lever to move downwards, pivoting about its left-hand end which is now the fulcrum.

357 (9) This breaks the circuits through the switch and if the mounting be stopped, training while the roller is on the first step, the circuits will remain broken until the guns are elevated sufficiently to raise the left-hand end of the floating lever (pivoting about its right-hand end) to the point where the circuits are once again made.

The angle of elevation at which the circuits may safely be "re-made", while the roller is on the first step is of course dependent upon the local connections and to train this angle determines the height of the first step of the cam rail. The circumferential length of the first step is also governed by local conditions. Further elevation of the guns, whilst with the bearing controlled by the first step merely raises the roller from the rail, the circuits remaining made. When the roller is returned to the rail by depressing the guns, the right-hand end of the floating lever becomes the fulcrum and any further depression breaks the circuits.

357 (10) If the mounting be trained further, the roller may ride over other steps whose height will be governed by the extent of the local connections which demand such other steps. The operation of the gear will remain the same as has just been described but the guns must be elevated to a greater or lesser angle before the circuits are "re-made".

#### STRIPPING DOWN THE GEAR

357 (11) The gear is readily accessible and only two components, the safety firing switch and the spring-loaded plunger, require any remarks on stripping.

#### The Safety Firing Switch.

357 (12) A cover on the top of the upper chamber gives access to the terminals for examining the cables and connections. On the front of the upper chamber an inspection door is provided through which it is possible to see the contact segments on the top of the plunger and the lower ends of the terminals.

If the switch requires an overhaul it should be removed to the bench for stripping down.

#### TO REMOVE THE SWITCH.

357 (13).—(a) Remove the top cover and disconnect the cables.

- (b) Remove the pins connecting the end of the floating lever with the linkage system.
- (c) Disconnect the rod to the indicator quadrant.
- (d) Remove the four bolts securing the bracket to the carriage plate.

#### TO REMOVE THE PLUNGER

(After the complete switch has been removed from the mounting.)

357 (14).—(a) Remove the indicator operating gear.

- (b) Remove the bolts joining the two parts of the floating lever and take each half off the trunnion pins.
- (c) Remove the nut on the end of the plunger rod.
- (d) Remove the sleeve.
- (e) Remove the locking screw securing the anti-backlash spring housing.
- (f) Unscrew the anti-backlash spring housing and remove it from the guide tube.
- (g) Withdraw the plunger.

## TO REMOVE THE CONTACT SEGMENTS.

(After the removal of the plunger.)

357 (15). (a) Remove the split pin from the plunger rod just below the piston portion.

(b) Unscrew the centre screw visible on the upper face of the piston. The various portions of the contact segments can then be removed.

## The Spring-Loaded Plunger.

## TO REMOVE A SPRING

357 (16).—(a) Remove the nut from the top of the plunger.

(b) Lift off the cross-head.

(c) Remove the locking bolt from the guide bracket.

(d) Unscrew and remove the spring retaining cap.

The upper spring can then be removed and, by lifting the plunger, the distance piece and the lower spring can be removed.

## TO REMOVE THE GUDGEON PIN. (After the removal of the springs.)

357 (17) After the removal of the springs, it may be possible to use the lock up clear of the gudgeon pin and push it out of the plunger. But if the liner is stiff the plunger will have to be withdrawn from the guide bracket.

## TO REMOVE THE PLUNGER

(After the removal of the springs.)

357 (18) Remove the pin from the lower end of the link and withdraw the plunger.

## INTERCEPTOR, MARK 4 and 6

## Plates 25 and 25A

## Interceptor, Mark 4.

358 One interceptor is fitted at each gun and carries contacts for the firing and gun ready lamp circuits which can be made only when the mounting is trained on to a safe bearing.

359 The upper contacts box is pivoted to the balance ring and therefore recoils with the gun. It accommodates the actuating lever, actuating and catch bars, toggle lever and change over rod. The latter is pushed horizontally when changing from main to auxiliary circuit and is locked in position by means of a spring catch.

360 The lower contacts box is pivoted on a bracket secured to a non-recoiling part of the mounting and carries a hand grip and palm lever for closing the interceptor. It is retained in its closed position by a spring loaded catch bolt which is supported by the catch bar of the upper contacts box. The interceptor can be opened by pulling the catch bolt outwards and allowing the lower contacts box to fall.

361 Unreliable operation of the safety firing gear may be due to wear of the stop piece on the falling contacts box. It is essential that this stop piece should be of steel. Earlier interceptors were made with this stop piece as part of the gun mechanism. Interceptors should therefore be examined to see if they have been modified and if not Modification No. 23 is to be carried out immediately.

362 **Warning.** No attempt must be made to close the interceptor if the danger position indicator shows red. If a indicator is provided to show when the safety firing gear has operated, but it may be possible with too much or bad adjustment to close the interceptor sufficiently to complete the firing circuit even though it will not remain closed. The warning given by the indicator must therefore never be neglected.

## OPERATION OF THE INTERCEPTOR.

363 As the mounting approaches a danger zone the push rod of the safety firing gear operates the actuating lever which moves the spring loaded catch bar to the rear. At the same time the actuating bar is moved in the opposite direction by the action of the toggle lever and exposes a red danger indicator.

364 In moving to the rear the catch bar releases the catch bolt supporting the lower contacts box and the firing and gun ready lamp circuits are broken as the lower contacts box falls under pressure from a spring plunger.

365 Further movement of the actuating bar prevents the interceptor from being closed, while the mounting is in the danger zone, by the end on the actuating bar projecting over the stop piece of the lower contacts box.

366 When the mounting is trained into a safe zone, the sliding bars are returned to their normal position by the return spring and the interceptor can be closed by hand.

367 It should be noted that the interceptor is opened in a similar manner when the guns recoil by the catch bar releasing the catch bolt and allowing the lower contacts box to fall.

## INTERCEPTOR FOR MOUNTINGS FITTED WITH SAFETY FIRING SWITCH.

368 On some mountings fitted with safety firing switch the Mark 4 interceptor is used, but it is modified by the omission of the parts operating the original safety firing gear. For later mountings and future manufacture the interceptor Mark 6, as shown on Plate 25A, is fitted.



**Interceptor, Mark 6.**

369 The Mark 6 interceptor consists of an upper and lower contact box with single firing contacts and two gun ready pump contacts, but does not contain the catch bar and actuating bar mechanism or the Main "AUXILIARY" change over rod of the Mark 4. The catch bolt of the lower contact box latches on a catch bracket.

This type of interceptor can be made at any time when the gun is fully run out.

370

**CHAPTER IV—SECTION 3. ELEVATION RECEIVER—MECHANICAL POINTER DRIVE**

**Plate 25.**

371 The elevation receiver is provided with a mechanically operated follower pointer which is driven through a spur pinion (spring loaded to reduce backlash), shafting and bevel gearing (blue from the sight arc purple). The shaft can be readily removed by withdrawing the spur pins from the muff couplings at either end and sliding them inwards.

The receiver has a jaw coupling which engages with a corresponding member on the driving shaft this allows for easy removal of receiver.

372 A vernier adjustment is inserted in the drive, just below the elevation receiver to facilitate lining up the pointer.

An adapter is provided where certain types of receivers are fitted and the drive is extended through a pair of bevel gears to the coupling at the rear of the receiver as shown on the plate.

**ADJUSTMENT.**

373 To line up the pointer:—

- Snacken back the vernier adjustment coupling nut and slide the clutch sleeve back releasing the clutch plate.
- Line up the pointer by rotating the jaw coupling until the correct setting is obtained.
- Rotate the clutch plate until a position is found where the serrations on each side coincide with the serrations on the clutch sleeve and dog clutch.
- Slide the clutch sleeve forward and replace the coupling nut finally locking the grub screws.

**LUBRICATION.**

374 Oils provide lubrication to the gear wheels and grease nipples are fitted in positions indicated on the plate.

~~operation.~~

(G. 07778/48—A.F.O. P.71/58.)

Page 32C. (Inserted by A.F.O. P.71/58.)

Last line. Delete "375-380" and insert:—

**SAFETY FIRING GEAR FOR THE ROCKET FLARE LAUNCHERS**

**Plate 24B**

375 The safety firing gear for the launchers consists of a safety firing switch (A.P. 5061 modified) operated by a spring-loaded plunger and roller which rides on a cam rail when the mounting is trained on a dangerous bearing.

**OPERATION.**

When the mounting is trained on to a dangerous bearing the spring-loaded plunger is forced up as the roller is along the incline of the cam rail and operates the safety firing switch which opens the firing circuits.

The firing circuits are shown in Plate 76B.

Complete detail of the operation of the rocket flare launcher is given in B.R. 924.

376-380

(G. 01894/48—A.F.O. P.266/58.)

## CHAPTER V

### SECTION I—TRAINING GEAR

#### Plate 27

381 The training gear is operated from the right-hand side of the mounting by means of two handles attached to crank arms which are carried by a support bracket attached to the carriage.

382 A ball race is fitted in a cap at the top of the support bracket and forms the bearing for the crank arm shaft.

383 The cap from the handle turns a pair of bevel wheels which is the upper bevel gear box and is transmitted through the bevel gear shaft to another pair of bevel wheels which is the lower bevel gear box and thence to the worm shaft.

384 The bevel gear shaft is made in three parts joined by sliding couplings to facilitate stripping. A hole is provided in the carriage side for the worm shaft to be removed.

385 The receiver is provided with an anti-dive seat and adjustable foot rest. The platform and the training receiver are connected by a chain from the receiver to the platform. The receiver is provided with a handle which is used to move the receiver to the complete turn of the handles training the mounting through 4 deg.

#### STRIPPING

386 (1) Remove the split pin securing the crank arm handle with the worm gear box bearing shaft.

(2) Remove the support bracket cap and remove it and remove the driving handle and crank covers.

(3) Remove upper bevel gear box remove outer cover together with driving shaft and driving bevel wheel.

(4) Take out upper and lower shaft cover cap and remove the upper shaft coupling and the lower shaft coupling so as to withdraw along its shaft and remove the upper shaft for the mating coupling.

(5) Remove the lower bevel gear box together with the lower bevel wheel and pump.

(6) Remove the lower bevel gear box together with the lower bevel wheel and pump. Take out the pin for access to worm shaft to facilitate the withdrawal of the worm shaft. Remove the securing nut for the bevel wheel. Take off the cover on the worm gear box for access to the worm.

(7) Withdraw the worm shaft remove worm and thrust bearings, also worm shaft bevel wheel.

(8) Take out the bolts securing the worm gear box and remove complete.

Note.—If required, the lower bevel gear box, worm shaft and worm gear box can be removed intact to the bench for inspection and stripping down.

387 All gears run in oil baths and lubrication is provided to all ball races.

#### TRAINING WORM GEAR DRIVE MARK XIX MOUNTING

#### Plate 28

388 The training pinion is positioned at the front of the mounting, on the fore and aft centre line and is driven by a worm shaft through a worm wormwheel and friction gear.

389 The worm shaft is operated by the training handles through an upper and lower pair of bevel wheels, the latter being mounted on the plate.

390 The worm gear box is supported in the top of the carriage plate and carries the worm wheel which is held in position by the box with the worm gear box. The worm gear box is supported in the top of the carriage plate and carries the worm wheel which is held in position by the box with the worm gear box.

391 Oil baffles formed on the underside of the wormwheel and in the gear box prevent the leakage of oil past the vertical pinion shaft.

392 The wormwheel is hollow and contains the friction discs. Alternating steel and gun metal friction discs are assembled in the wormwheel.

393 The steel discs (yellow) are keyed to the pinion shaft and the gun metal discs (orange) are keyed to the inside of the wormwheel. Tapped lugs are provided on the discs to facilitate their withdrawal.

394 The friction discs are loaded by Belleville washers which bear down upon the washer A. Washer A is held in position by the other washer or distance plate. The latter is screwed down.

and compresses the Belleville washers. It is prevented from unscrewing by the locking plate which is set into the distance plate. The amount of compression is such that the clutch will not retract unless a force of approximately seven tons is applied at the training rack.

395. The nut, locking plate, distance plate, Belleville washers, adjustment washer, washer A and the steel friction discs rotate, as one with the pinion shaft.

Ball thrust bearings are arranged at each end of the worm shaft to take the axial thrust in either direction.

396. A screwed adjusting bush is fitted to take up any slackness in the worm thrust bearings which may occur through wear.

When stripping down, the adjusting bush should not be touched once it is set unless it is necessary.

### THE TRAINING WORM GEAR DRIVE MARK XI MOUNTING.

397. The training pinion is positioned at the front of the mounting on the fore and aft centre line and is driven by a worm shaft through a worm, wormwheel and friction gear.

398. The worm shaft is operated by the training handles through an upper and lower pair of bevel wheels, the latter being indicated on the scale.

399. The worm gear box is spigotted in the top racer carriage plate and secured by top bolts, while a thrust key is fitted which registers the position of the box with relation to the carriage plate. The worm runs in an oil bath formed in the gear box.

400. The wormwheel is hollow and contains the friction discs. Alternate steel and gun metal friction discs are assembled in the wormwheel.

401. The steel discs (yellow) are keyed to the pinion shaft and the gun metal discs (orange) are keyed to the inside of the wormwheel. Tapered pins are provided in the discs to facilitate their withdrawal.

402. The friction discs are loaded by Belleville washers which bear down upon the washer A. Washer A is keyed to be short as the other washer or distance plate. The nut is screwed down and compresses the Belleville washers. It is prevented from unscrewing by the locking plate which is set into the distance plate. The amount of compression is such that the nut will not retract unless a force of approximately one ton is applied at the training rack.

403. The nut, locking plate, distance plate, Belleville washers, adjustment washer, washer A and the steel friction discs rotate as one with the pinion shaft.

Ball thrust bearings are arranged at each end of the worm shaft to take the axial thrust in either direction.

404. A screwed adjusting bush is fitted to take up any slackness in the worm thrust bearings which may occur through wear.

When stripping down, the adjusting bush should not be touched once it is set unless it is necessary.

405—410

### CH. V SECTION 2 - TRAINING BUFFER, TRAINING LIMIT STOP AND HOUSING LOCKING BOLT

411. The design of the training buffer is such that the plunger moves back to the normal, out position with a quick return motion.

412. The training buffer contains two cylinders filled with oil in which works the plunger with a central collar.

413. In each cylinder there is a thrust ring and a loose piston which are grooved. The piston is normally kept central by springs.

414. The action of the training buffer is as follows:—When the plunger comes against the training stop, assuming that the buffering takes place from the right-hand side, the spring is compressed in the left hand chamber until the collar on the plunger comes into contact with the loose piston.

This seals the oil in the left-hand chamber except for the small escape groove in the periphery of the piston.

415. When the mounting is trained off the stop in the reverse direction, the spring acting on the thrust ring separates the collar on the plunger from the loose piston allowing air oil to escape through the grooves in the thrust ring and causing a quick return.

416. In order to fill the buffer rapidly the pin in the bracket carrying the buffer may be withdrawn and the buffer placed on end.

The retaining nut can be unscrewed and the chamber completely filled.



417 Before replacing the retaining nut the valve plug should be removed to allow any air to Page 35, paragraph 418. *Cancel and substitute:—*

418. The housing bolt works through a bracket fitted to the right rear of the top racer carriage. It is operated by hand and a locking pin secures it both in the 'secure' and in the 'free' positions ~~the right~~ on the mounting as required.

A stop piece is secured to the top of the housing bolt bracket in such a position as to prevent the locking pin being inserted in the upper hole of the bolt above the bracket (Plate 30A) and are

For later mountings the housing bolt bracket is fabricated the housing bolt handle is at the top of the bolt and a locking screw keeps the bolt in alignment with the bracket as shown on Plate 30A.

To secure the mounting, the bolt is engaged in the housing stop on the lower racer base plate.

420. One Tucker's oiler in the training receiver. (G. 06965/47.—A.F.O. P.355/47)

One Ennot's lubricator in the housing locking bolt bracket,

421. 425.

## CH V SECTION 3—TRAINING RECEIVER—MECHANICAL POINTER DRIVE

### Plate 31

426. The training receiver is provided with a mechanically operated "follower" pointer which is driven through a split pinion (spring loaded to reduce backlash) shafting and bevel gearing (blue) from the training rack. The shaft can be readily removed by withdrawing the split pins from the stuff couplings at either end and sliding them inwards.

The receiver has a jaw coupling which engages with a corresponding member on the driving shaft, thus allows for easy removal of receiver.

427. A vernier adjustment is inserted in the drive, just below the training receiver, to facilitate lining up the pointer.

428. Adaptors are provided for receivers of other types (typical examples illustrated on plate).

429. Provision is made, in the case of receivers having the jaw coupling situated at the rear for extending the drive through the small bevel gears.

430. The gear ratio can be altered to suit the small type training receivers by introducing a pair of spur wheels housed in the adaptor.

431. The direction of rotation of the pointers in small type training receivers may be reversed by altering the position of the main bevel drive in the instrument.

432. A wormwheel driven by the worm in the training receiver drive operates the drive (green) to the Evershed bearing receiver, where fitted.

### ADJUSTMENTS

433. To line up the pointer:—

(1) Slacken back the vernier adjustment coupling nut and slide the clutch sleeve back, releasing the clutch plate.

(2) Line up the pointer by rotating the jaw coupling until the correct setting is obtained.

(3) Rotate the clutch plate until a position is found where the serrations on each side coincide with the serrations on the clutch sleeve and the dog clutch.

(4) Slide the clutch sleeve forward and replace the coupling nut, finally locking with the grub screws.

### MAINTENANCE

434. Oilers provide lubrication to the gear wheels, and grease gun nipples are fitted in positions indicated on the plate.

435—440.

## CHAPTER VI

## SECTION I: THE SIGHTING ARRANGEMENTS

Plates 22, 23, 24, 25

441 The shafts are of the integral type and are mounted on a fixed frame of the machine. They are connected to the crank through gearing. The gear box is mounted and bolted to a frame on the left-hand side of the carriage.

[illegible]

443. The operation of the sight is as follows :—

## GETTING THERE

steering is set by turning the range handwheel and is powered by a gear which is connected to the differential gear which is on the elevation shaft. The elevation wormwheel segment is the elevation gear which is on the elevation shaft. The elevation gear is connected to the elevation shaft. An anti-siphon valve is located on the elevation shaft to prevent backflow.

## (2) GUN ELEVATION

As the guns are moved by the layer, the sights are, attached to the cradle concentrically with the gun in such a way that the sight portion of the gun can be rotated about the gun axis for differential gear and elevating brackets as before.

$\frac{d}{dt} \left( \frac{\partial L}{\partial \dot{x}} \right) = \frac{\partial L}{\partial x}$

### DRIFT CORRECTION

(colored red) which is operated by means of a lever secured to the range shaft extension. drift wormwheel.

#### (4) LATERAL DEFLECTION

[illegible]

444. The telescope holder brackets are arranged to take either Ross or Ottway monocular telescope together with any of the accessories listed below.

## STAR SHELL SPIRIT LEVEL

4-45 A locking screw is provided on the flange end of the level. The screw is used to lock the level in position when it is used as a reference level. The locking screw is provided on the casting for the star shell spiral level when not in use.

## BARRAGE NIGHTS

446 Barrage lights are fitted with the rear and front positions on the rear light and a double ring foresight. The outer ring corresponds to a target speed of 200 knots and the inner ring is a speed of 100 knots. The deflection of the light is indicated on the outer edge of the ring. The deflection necessary for these target speeds

The barrages shown are of the type known as "low head" and are usually found in the lower reaches of rivers.

Fluorescence light (see also for further information: e.g. [26], [27], [28], [29], [30], [31], [32], [33], [34], [35], [36], [37], [38], [39], [40], [41], [42], [43], [44], [45], [46], [47], [48], [49], [50], [51], [52], [53], [54], [55], [56], [57], [58], [59], [60], [61], [62], [63], [64], [65], [66], [67], [68], [69], [70], [71], [72], [73], [74], [75], [76], [77], [78], [79], [80], [81], [82], [83], [84], [85], [86], [87], [88], [89], [90], [91], [92], [93], [94], [95], [96], [97], [98], [99], [100], [101], [102], [103], [104], [105], [106], [107], [108], [109], [110], [111], [112], [113], [114], [115], [116], [117], [118], [119], [120], [121], [122], [123], [124], [125], [126], [127], [128], [129], [130], [131], [132], [133], [134], [135], [136], [137], [138], [139], [140], [141], [142], [143], [144], [145], [146], [147], [148], [149], [150], [151], [152], [153], [154], [155], [156], [157], [158], [159], [160], [161], [162], [163], [164], [165], [166], [167], [168], [169], [170], [171], [172], [173], [174], [175], [176], [177], [178], [179], [180], [181], [182], [183], [184], [185], [186], [187], [188], [189], [190], [191], [192], [193], [194], [195], [196], [197], [198], [199], [200], [201], [202], [203], [204], [205], [206], [207], [208], [209], [210], [211], [212], [213], [214], [215], [216], [217], [218], [219], [220], [221], [222], [223], [224], [225], [226], [227], [228], [229], [230], [231], [232], [233], [234], [235], [236], [237], [238], [239], [240], [241], [242], [243], [244], [245], [246], [247], [248], [249], [250], [251], [252], [253], [254], [255], [256], [257], [258], [259], [260], [261], [262], [263], [264], [265], [266], [267], [268], [269], [270], [271], [272], [273], [274], [275], [276], [277], [278], [279], [280], [281], [282], [283], [284], [285], [286], [287], [288], [289], [290], [291], [292], [293], [294], [295], [296], [297], [298], [299], [300], [301], [302], [303], [304], [305], [306], [307], [308], [309], [310], [311], [312], [313], [314], [315], [316], [317], [318], [319], [320], [321], [322], [323], [324], [325], [326], [327], [328], [329], [330], [331], [332], [333], [334], [335], [336], [337], [338], [339], [340], [341], [342], [343], [344], [345], [346], [347], [348], [349], [350], [351], [352], [353], [354], [355], [356], [357], [358], [359], [360], [361], [362], [363], [364], [365], [366], [367], [368], [369], [370], [371], [372], [373], [374], [375], [376], [377], [378], [379], [380], [381], [382], [383], [384], [385], [386], [387], [388], [389], [390], [391], [392], [393], [394], [395], [396], [397], [398], [399], [400], [401], [402], [403], [404], [405], [406], [407], [408], [409], [410], [411], [412], [413], [414], [415], [416], [417], [418], [419], [420], [421], [422], [423], [424], [425], [426], [427], [428], [429], [430], [431], [432], [433], [434], [435], [436], [437], [438], [439], [440], [441], [442], [443], [444], [445], [446], [447], [448], [449], [450], [451], [452], [453], [454], [455], [456], [457], [458], [459], [460], [461], [462], [463], [464], [465], [466], [467], [468], [469], [470], [471], [472], [473], [474], [475], [476], [477], [478], [479], [480], [481], [482], [483], [484], [485], [486], [487], [488], [489], [490], [491], [492], [493], [494], [495], [496], [497], [498], [499], [500], [501], [502], [503], [504], [505], [506], [507], [508], [509], [510], [511], [512], [513], [514], [515], [516], [517], [518], [519], [520], [521], [522], [523], [524], [525], [526], [527], [528], [529], [530], [531], [532], [533], [534], [535], [536], [537], [538], [539], [540], [541], [542], [543], [544], [545], [546], [547], [548], [549], [550], [551], [552], [553], [554], [555], [556], [557], [558], [559], [560], [561], [562], [563], [564], [565], [566], [567], [568], [569], [570], [571], [572], [573], [574], [575], [576], [577], [578], [579], [580], [581], [582], [583], [584], [585], [586], [587], [588], [589], [590], [591], [592], [593], [594], [595], [596], [597], [598], [599], [600], [601], [602], [603], [604], [605], [606], [607], [608], [609], [610], [611], [612], [613], [614], [615], [616], [617], [618], [619], [620], [621], [622], [623], [624], [625], [626], [627], [628], [629], [630], [631], [632], [633], [634], [635], [636], [637], [638], [639], [640], [641], [642], [643], [644], [645], [646], [647], [648], [649], [650], [651], [652], [653], [654], [655], [656], [657], [658], [659], [660], [661], [662], [663], [664], [665], [666], [667], [668], [669], [670], [671], [672], [673], [674], [675], [676], [677], [678], [679], [680], [681], [682], [683], [684], [685], [686], [687], [688], [689], [690], [691], [692], [693], [694], [695], [696], [697], [698], [699], [700], [701], [702], [703], [704], [705], [706], [707], [708], [709], [710], [711], [712], [713], [714], [715], [716], [717], [718], [719], [720], [721], [722], [723], [724], [725], [726], [727], [728], [729], [730], [731], [732], [733], [734], [735], [736], [737], [738], [739], [740], [741], [742], [743], [744], [745], [746], [747], [748], [749], [750], [751], [752], [753], [754], [755], [756], [757], [758], [759], [760], [761], [762], [763], [764], [765], [766], [767], [768], [769], [770], [771], [772], [773], [774], [775], [776], [777], [778], [779], [780], [781], [782], [783], [784], [785], [786], [787], [788], [789], [790], [791], [792], [793], [794], [795], [796], [797], [798], [799], [800], [801], [802], [803], [804], [805], [806], [807], [808], [809], [810], [811], [812], [813], [814], [815], [816], [817], [818], [819], [820], [821], [822], [823], [824], [825], [826], [827], [828], [829], [830], [831], [832], [833], [834], [835], [836], [837], [838], [839], [840], [841], [842], [843], [844], [845], [846], [847], [848], [849], [850], [851], [852], [853], [854], [855], [85

## SAFETY TRAINER'S SIGHT

447 A simple type of low and broad, a "transverse" sight can be mounted on the low or right side of the gun shield. A stowage box is provided on the left side of the gun for the sight.

[illegible]

### ADJUSTMENTS

448 **For elevation.** The sequence and method of adjustment are as follows —

Set the telescope parallel to the gun bore by means of the range handwheel and set the range dial zero. Bring the telescope into line by the **adjustment for elevation** provided on the telescope housing. This adjustment is the usual type of eccentric bolt and block.

449 **For line.** The sequence and method of adjustment are as follows —

Set the telescope parallel to the gun bore by means of the deflection handwheel and set the deflection dial zero. Bring the telescope into line by the **adjustment for lateral lining-up** provided at the trunnion end of the deflection cross-connecting shaft. This adjustment is in the form of two damped check nuts and a screw housed in the trunnion block.

450 **Stop gear on range handwheel.** The required movement of the telescopes in elevation is 30 deg. tangent elevation (movement below line of gun) and 5 deg. tangent depression (movement above line of gun).

Set the telescopes to 5 deg. tangent depression by means of the range handwheel. The range index will then coincide with the scale mark for half of stop position and the stop gear should be set to act exactly at this position so that when changing dials to correct for a variation in movement setting point is always maintained. To adjust the stop gear, slacken both bolts in the flange behind the range handwheel and withdraw the handwheel and spindle sufficiently to disengage the stop gear at top of pinion. Rotate the pinion in the direction necessary to set tangent depression, until the stop pin is flush with the handwheel back and retighten the bolts.

451 **Stop gear on deflection handwheel.** The required movement of telescopes R or L deflection and the stop gear is set in a manner similar to that for the range stop, allowing each maximum deflection to be covered by the same amount.

452 **Barrage sight.** Adjustment for vertical lining-up is provided on the foresight where the hole for the sighting screws are engaged threads. Adjustment for lateral lining-up is provided on the base rear sight in the form of two check nuts.

453 **Anti-Backlash.** The elevation worm, deflection worm and the worm on the vertical shaft in the range handwheel are set to permit adjustment of wear. The wormwheels in the deflection dial, vertical and horizontal gear wheel on the range handwheel are also put on the back of each wheel a square on a spiral key so that adjustment may be made by introducing a shim between the leaves of the wheels.

Backlash in the thread of the screw and the deflection cross-connecting shaft is eliminated by an **anti-backlash spring** wound in a clockwise effort required to produce right or left deflection and which thus maintains pressure in one direction on the screw.

### MAINTENANCE

454 **Drop-feed lubricators** provide lubrication for the elevation worm and segment the upper drift wheels, the spiral gear driving the range handwheel worm gear, the range dial, the range and deflection dial screws and horizontal gear wheel on the range handwheel and the range and deflection dials for the left worm spindle. Grease gun nozzles are fitted for lubrication of all other working parts and drain plugs are provided at two points in the right gear box. *See plate 40*

### STRIPPING

455 (1) **Disassemble and remove lamps from range and deflection dials.** Remove range and deflection dial sockets. Remove range and deflection dial by loosening clamping screws. Remove and bolt the range and deflection dial. Drain all oil from the gear box.

(2) Remove cover covers on upper portion of gear box and withdraw range dial spindle with spiral gear wheel.

(3) Extract sides of the spiral extract bolts securing the swivel pins in the deflection arms and remove swivel pins. Swing the deflection arms clear of the trunnion blocks.

(4) Remove deflection pivot pins and detach deflection arms.

(5) Remove cover from power portion of gear box.

(6) Remove the lower portion of deflection shaft and extract taper pin in combined level gear and worm at upper end of shaft.

(7) Tap deflection shaft upwards and withdraw it from gear box and remove distance pieces, thrust washers and worm as required. Note that the shaft is a pinion and withdraw the pinion sufficiently to release deflection worm and leave shaft in position until gear box is detached from carriage.

(8) Remove deflection dial spindle and wormwheel.

(9) Remove bevel gear on vertical shaft in drive from range handwheel.

(10) Remove pin on top of gear box. Tap shaft upwards and remove worm, distance pieces and thrust washers. Shaft is withdrawn.

(11) Remove drift bevel wheel at lower end of range shaft.

(12) Extract taper pin in distance piece adjacent to differential and taper pins in spiral gear pinion and wormwheel.

(13) Withdraw range shaft from gear box and remove parts thus released.

(14) Release and withdraw cover over double thrust washer on elevation shaft. Extract taper pins in collar on elevation shaft.

(15) Remove bevel gear from end of elevation shaft. Withdraw elevation shaft into upper portion of gear box and remove parts thus released. Remove elevation shaft by passing it through lower portion of gear box.

(16) Remove **trunnion block** at trainer's side of deflection cross-connecting shaft by unscrewing domed nut and check nuts.

Extract taper pin in nut for **anti-backlash spring**. Unscrew nut and withdraw spring.

(17) At layer's side remove cheese head screws behind deflection wormwheel. Withdraw deflection wormwheel complete with cross-connection from the gear box. (To facilitate dismantling in a limited space the cross-connecting shaft may be withdrawn in sections by extracting the taper pins in the cross-connecting tube.)

(18) Remove bolts securing **elevation wormwheel segment** to elevating bracket and withdraw segment.

(19) Remove bolts securing sight gear box to carriage and remove gear box. (Holes are provided in the left hand elevating bracket so that a small drift may be used to release ball bearing.)

(20) Remove bolts securing trunnion bracket to carriage. Remove trunnion bracket together with elevation cross-connecting tube, balance weight and elevating brackets.

(21) Remove the set screws positioning balance weight on tube. Remove keepe to release balance weight.

(22) Remove check nuts from trainer's end of cross-connection tube and withdraw elevating bracket.

(23) Remove cover on trunnion bracket and remove ball bearing. (Holes are provided for use of a small drift for this purpose.)

(24) Remove cover plate retaining ball bearing in gear box and withdraw ball bearing. (Holes are provided for use of a drift for this purpose.)

456. Re-assemble in reverse order. Before re-assembly of cover (covered in paragraph 455 (4)), the cover should be filled with grease.

457-460.

(to 457) 457 458 459 460

## SECTION 2—METHOD OF SIGHT TESTING

### PARALLELISM TEST

461. **Purpose.**—To see that the line of sight is parallel to the gun bores.

462. **Procedure.**—Bore telescopes and muzzle crosswires should be shipped and lined up on a target board marked out in accordance with diagram A or B and set up at some convenient distance normal to the gun bores. The crosswires of the gun sighting telescopes should now be found to be aligned exactly on their corresponding crosses on the board. If necessary adjustment should be carried out in accordance with the paragraphs 448, 449.

If preferred, the use of a target board may be dispensed with by lining up both gunsighting and bore telescopes on some distant object (e.g., a church spire).

### GRADUATION TEST

463. **Purpose.**—To check agreement of guns, telescopes and range dial graduations.

In carrying out this test it should be observed that in order to determine the amount of backlash in the gearing two readings are taken for each gun elevation—one lowering and the other raising the sight. It is therefore apparent that each setting on the sight should be approached carefully in the direction indicated without over-running and returning.

464. **Procedure.**—(1) Ship dummy telescope (1 per 'C' set) in place of layer's monocular telescope.

(2) Place clinometers on the planes provided on both gun and dummy telescope.

(3) Set guns and telescopes horizontal and adjust range dial (M.V. 2,650 f.s., if necessary by releasing clamping plate and re-setting to read zero range against index).

(4) Elevate guns to first value shown in left-hand column of table.

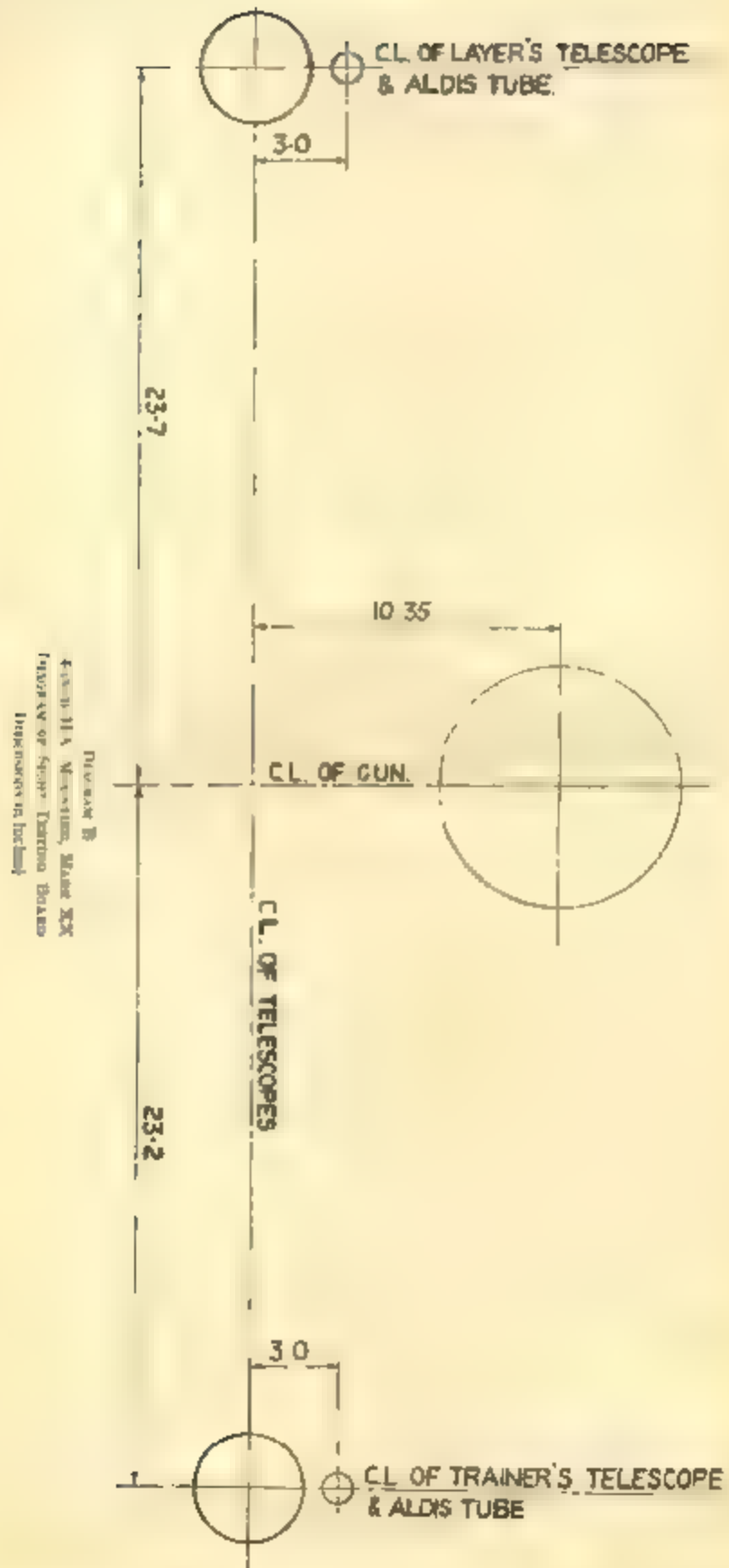
(5) Depress sight to horizontal position by means of range handwheel and note range dial reading.

(6) Depress sight still further a small amount, return to original setting and again record range dial reading.

(7) Repeat above process for all values shown in left-hand column of table.







Tabulate as below:—

Elevation of Gun when Sight Horizontal	Corresponding Range from Sight Testing Table Yards	Range on Sight			
		Lowering the Sight		Raising the Sight	
		Reading Yards	Error Yards	Reading Yards	Error Yards
Depts.	3,330				
2	3,800				
	etc.				

The test is considered satisfactory if the ranges indicated are within 25 yards of those shown in the table.

### DEFLECTION TEST

**465 Purpose.** To check the accuracy of the deflection gearing and deflection dial graduations. It should be noted that two readings are taken for each deflection setting, one increasing and the other decreasing deflection, in order to measure the amount of backlash in the gearing. Care should therefore be taken to approach the deflection setting in the manner indicated without over-running and returning.

**466 Procedure.**—(1) Mark off target board as shown on diagram "C."

(2) Lay the guns horizontal, train the mounting on to a suitable bearing, and set the deflection dial to zero by operating the deflection handwheel.

(3) Place the board at a distance of exactly 25 ft. from the centre pivot of the mounting, adjusting it square to the sight line and level so that the crosswires of both layer's and trainer's telescopes are on the zero lines.

(4) Apply left deflection by rotating the deflection handwheel until the crosswires of the trainer's telescope are on the first setting mark on the board and note the deflection dial reading.

(5) Increase the deflection slightly, return the telescope to its original setting, and again note the reading on the dial.

(6) Repeat 4. and 5) above, using the layer's telescope, taking care to approach the setting in the same manner to that for the trainer's telescope. Note the deflection dial readings.

(7) Repeat the above sequence of operations for all deflection setting marks for both right and left deflection.

Tabulate as below, observing that a comparison of the readings for layer's and trainer's telescopes serves as a check for the accuracy of the cross connection.

Deflection Dial Readings (in units)

Lateral Deviation of Telescope Right or Left Units	Trainer's Telescope				Layer's Telescope			
	Left Deflection		Right Deflection		Left Deflection		Right Deflection	
	In. Increasing	Out. Increasing	In. Increasing	Out. Increasing	In. Increasing	Out. Increasing	In. Increasing	Out. Increasing
10								
20								
30								
etc.								

The test is considered satisfactory if the readings obtained are within  $\frac{1}{2}$  unit (3 minutes) of those shown in the left-hand column of the table above.

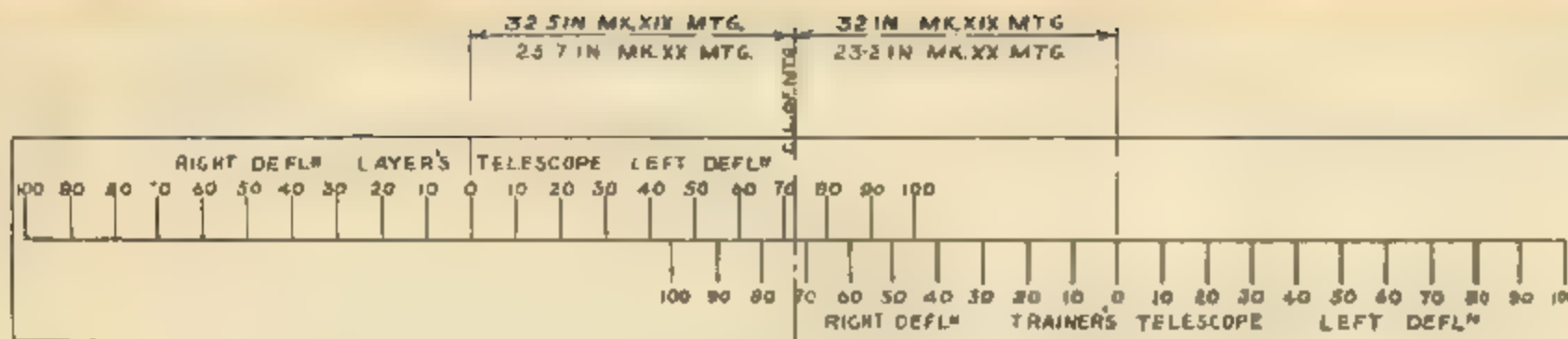
### DRIFT CORRECTION TEST

**467 Purpose.** To check accuracy of drift mechanism.

**468 Procedure.**—(1) Set deflection dial to zero.

(2) Secure dummy telescope in place of layer's monocular telescope and set guns and telescope horizontal by clinometers.

(3) Remove dummy telescope and replace monocular telescope.



LATERAL DEFLECTION OF TELESCOPE RIGHT OR LEFT		DEFLECTION DIAL READINGS RIGHT OR LEFT	DISTANCE OF GRADUATION FROM ZERO IN INCHES			
			LAYERS TELESCOPE - RIGHT DEFLN		LAYERS TELESCOPE - LEFT DEFLN	
			TRAINERS TELESCOPE - LEFT DEFLY		TRAINERS TELESCOPE - RIGHT DEFLY	
DEGS.	MIN.	UNITS	MK. XIX MTG.	MK. XX MTG.	MK. XIX MTG.	MK. XX MTG.
1	0	10	4.54	4.57	4.54	4.57
2	0	20	8.08	8.5	9.08	9.5
3	0	30	13.63	13.74	13.62	13.73
4	0	40	18.9	18.33	18.17	18.31
5	0	50	22.76	22.94	22.73	22.91
6	0	60	27.35	27.56	27.31	27.52
7	0	70	31.95	32.2	31.9	32.14
8	0	80	36.58	36.86	36.5	36.78
9	0	90	41.23	41.54	41.3	41.45
10	0	100	45.9	46.26	45.79	46.14
TARGET BOARD TO BE SET AT A DISTANCE OF 25 FEET FROM C.L. OF PIVOT OF MTG.						

Diagram C  
Diagram of Deflection  
Target Board  
Above.



(4) Set a target board marked with a cross (the deflection target board may be used at a convenient distance from the mounting and adjust it until the horizontal and vertical lines of the cross coincide exactly with the crosswire of the telescope.

(5) Elevate the gun and set by clinometer to the first value given in the left hand column of the table of "drift correction readings."

(6) Operate the range and deflection handwheels of the sight until the telescope crosswires again coincide exactly with the target cross and note the deflection dial reading.

(7) Repeat for all values given in the Table and tabulate as shown.

An alternative but less accurate test can be carried out without the use of a clinometer as follows:—

(1) Use a target board as above (for this test it is not necessary for target cross to be horizontally opposite to the telescope).

(2) Set range dial to read zero range and operate the training and elevating handles of the gun to bring the telescope crosswires to bear on the target cross.

(3) Set range dial to reading given in centre column of table of "drift correction readings."

(4) Operate elevating handle and deflection handwheel to bring telescope crosswire to bear again on the target cross and note deflection dial reading.

(5) Repeat for all values given in the table and tabulate as shown, substituting range for elevation in the first column.

Gun Elevation with Sight Horizontal	Deflection Dial Reading		Error + or -
	From Table	Actual	
Degs. 0	Units 0	Units 0	Units 0
10 etc.			

460 The test is considered satisfactory if the deflection dial readings obtained are within  $\frac{1}{2}$  unit (3 minutes) of the value shown in the right hand column of the drift correction table.

470-475.

### SIGHT TESTING TABLE.

RANGE DIAL READINGS. FULL CHARGE. MARK XVI\* GUN. M.V. 2,650 F.S.

In agreement with Range and Elevation Scales No. 370

Gun Elevation with Sight Horizontal	Range Dial Reading
Degs.	Yards
0	0
1	2233
2	2634
3	3018
4	3471
5	3885
6	4337
7	4768
8	5168
9	5546
10	5884
11	6184
12	6448
13	6678
14	6874
15	7038
16	7174
17	7284
18	7368
19	7427
20	7464

SIGHT TESTING TABLE *continued*

Gun Elevation with Sight Horizontal	Range Dial Reading
21	6600
22	6615
23	6630
24	6645
25	6660
26	6675
27	6690
28	6705
29	6720
30	6735

DRIFT CORRECTION READINGS, FULL CHARGE MARK XVI GUN M.V. 2,650 F.S.  
DRIFT CONSTANT 130.

Gun Elevation with Sight Horizontal	Range Dial Reading	Deflection Dial Reading
10	7400	0
11	7415	100
12	7430	200
13	7445	300
14	7460	400
15	7475	500
16	7490	600
17	7505	700
18	7520	800
19	7535	900

## CH. VI. SECTION 3—ELECTRICAL CIRCUITS

## Plates 384 &amp; 385

470 Two Junction Boxes, one on the left and one on the right of the mounting, are connected to the gun by flexible cables. The junction boxes are **Fixed Structure**, and are connected to the pivot of the mounting.

## FIRING CIRCUITS

477 The firing circuit is connected to the gun by a cable which runs from the gun layer's C.O.S. to the gun which is not to fire must be opened.

At the gun the circuit is connected to the gun layer's C.O.S. which is connected to the gun layer's C.O.S. by a cable.

## DIRECTOR FIRING and LOCAL

SEE ALSO PLATE 384 & 385

478 Mark IV interceptors which work in cooperation with the gun layer's C.O.S. are connected to the gun by a cable. They are of the falling contact type and are connected to the gun by a cable.

479 The gun layer's C.O.S. is connected to the gun by a cable. The gun layer's C.O.S. is connected to the gun by a cable. The gun layer's C.O.S. is connected to the gun by a cable.

## INSTRUMENT ILLUMINATING CIRCUITS

480 The instrument illuminating circuit is connected to the gun by a cable. The instrument illuminating circuit is connected to the gun by a cable.

481 The instrument illuminating circuit is connected to the gun by a cable. The instrument illuminating circuit is connected to the gun by a cable.

482 The instrument illuminating circuit is connected to the gun by a cable. The instrument illuminating circuit is connected to the gun by a cable.

b) Shackle guy wires to crossbeams and secure to any convenient deck fitting

### TO REMOVE A BARREL

495 Particular care must be taken to avoid damage to threads of the breech ring or to shoulders of the loose barrel. Clearances involved are very small, and the slightest burr on barrel shoulder will prevent it from entering jacket.

Reeve lifting wires over sheaves as shown in Fig. I and secure through 'Pul-Lift' block to anchor plate.

(2) Secure clamp around breech ring and run hauling part off at one corner. Plumb the lifting wire so that on hauling on the clamp the breech ring will unscrew.

(3) Unscrew breech ring, turn (45 degs) until the interrupted thread is disengaged.

*Note.* It may be necessary to use a wooden spar or handspike to start the breech ring if the thread is tight.

(4) Run gun right out so that breech ring is left hanging clear.

(5) Lower breech ring on to deck, and lay it on a wood packing.

(6) Reeve the lifting wires according to the arrangement shown in Fig. II.

(7) Erect the starting gear inside the gun barrel as shown in Plate 37. The strongback bearing on the rear of the balance weight and start to withdraw the barrel.

(8) Secure tackle to eyebolt and pull the barrel out for about a quarter of its length using a preventer secured to the eyebolt to ensure that the barrel does not run away due to its taper.

(9) Run trolleys along, and take the weight on the rear one by screwing up the nuts evenly. Further withdraw barrel and take weight on forward trolley before the barrel leaves the jacket. Position the trolleys as required so that axis of the centre of gravity of barrel. Run barrel out

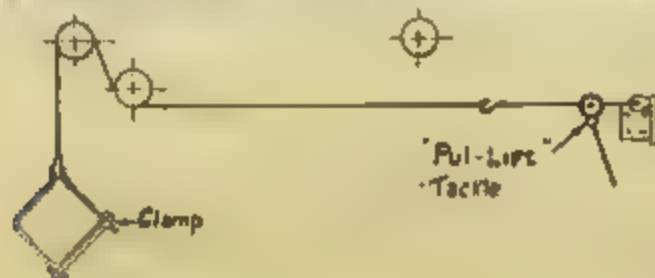


FIG. I

(Amendment No 27.)

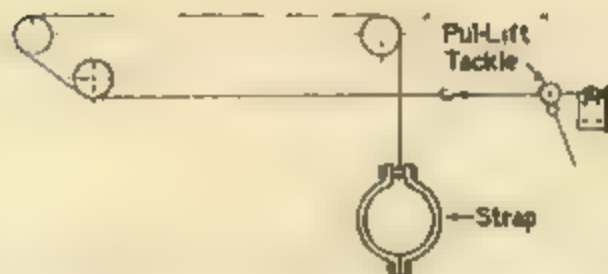


FIG. II

(10) Place lifting strap around barrel at its centre of gravity and lightly tighten the lower bolt. Secure thumbs of lifting wire to lifting strap by upper bolt. Take the weight through the 'Pul-Lift' block.

(11) Remove pins in trolleys allowing the vice blocks to fall, and keep muzzle end of barrel slightly lower than breech end to prevent slipping in the lifting strap.

Lower the barrel on to wooden blocks placed on deck to prevent weight being taken on the cross ties.

### REPLACING A NEW BARREL

496 The reverse procedure should be adopted, taking care before inserting barrel that

a) Muzzle end of barrel is concentric with the jacket.

b) Bore of barrel is parallel with the underside of the travelling beam. To effect this, adjust lifting screws until the measurement of distance of top of barrel below beam plus half diameter of barrel—is equal at either end of the traveller beam.

*Note.*—Further slight adjustment may be needed due to the bending of the beams under load.



497. Grease barrel, and when conditions (a) and (b) obtain, insert the barrel in the jacket.

*Note.*—Both left and right barrels should be capable of being withdrawn and replaced without repositioning the structure.

498. When the breech ring is replaced, care must be taken that the surfaces where the balance ring overlaps the breech ring are well served with thick graphited grease. Otherwise rust will occur and the breech ring may be difficult to remove at a subsequent occasion.

#### INSTRUCTIONS FOR CHANGING LOOSE BARRELS OF 4-IN. MARK 16, GUNS ON TWIN, MARK 16, MOUNTINGS IN SHIPS NOT EQUIPPED WITH BARREL CHANGING GEAR

499. This operation can be carried out by ship's staff without dockyard assistance provided a derrick (suitable one) can be erected and plumbed over the rear of the mounting.

The derrick should be fitted with a 2-ton working topping lift, a 2-ton pul-lift, and 2-ton chain purchase being secured at the head of the derrick.

Carry out the preparations to the gun as described in paragraph 485 1-8.

#### TO REMOVE A BARREL

500. Great care must be exercised in carrying out this operation to prevent any damage to the threads of the breech ring and the shoulders of the loose barrel. Clearances are very small and the slightest burr on the barrel shoulder will prevent it from entering the jacket.

(a) Reeve a 2½ in. wire strap around and through the right-hand side of the breech over suitable padding as in Figure III and hook on pul-lift from derrick head.

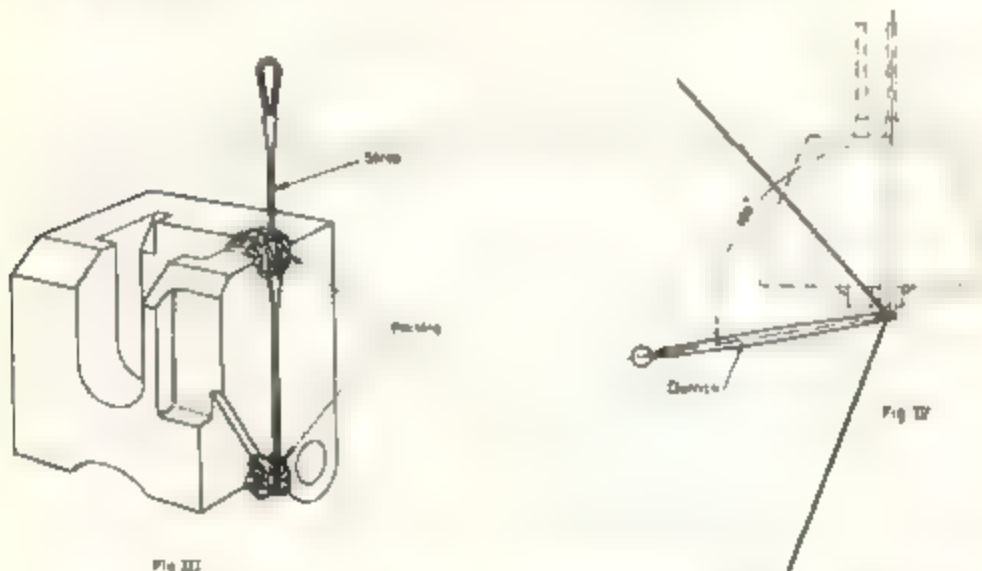
(b) Unscrew the breech ring one-eighth of a turn at the same time taking up any slack on the pul-lift.

*Note.*—It may be necessary to use a handspike to start the breech ring if the threads are tight.

(c) Run the gun right out so that the breech ring is left hanging clear.

(d) Lower the breech ring on to the deck on to wooden battens.

(e) Train the mounting until the axis of the gun bore is at 100° to the line of the derrick (see Fig. 4).



(f) Knock back the loose barrel until just clear of the jacket and secure a strap with suitable padding around rear end of barrel. Hook the strap to the end of the pul-lift. Insert a baulk of timber in the chamber of the barrel, and lash the strap to it to prevent it sliding along the barrel.

(g) Ease back the barrel at the same time training the derrick away from the mounting.

(h) When the centre of gravity of the barrel is clear of the jacket fit a strap at the centre of gravity over a suitable padding and hook on to the 2-ton chain purchase from the derrick head.

(i) Adjust the chain blocks, and work the derrick until the chain purchase is taking the weight and release the pul-lift.

(j) Train the derrick until the barrel is clear of the jacket then lower the barrel on to suitable blocks on the deck.

#### TO REPLACE THE BARREL

501. (a) Thoroughly clean the new barrel of all paint, to prevent any chips being scraped off when replacing the barrel and thus possibly causing the barrel to jam in the jacket.

- (b) Fit straps to new barrel at the centre of gravity and the rear end as on the removed inner. Hoist barrel and enter into the jacket in the reverse order for removal.
- (c) When the barrel is as far home as possible assemble the muzzle clip, as used in the hauling back gear, to the barrel and train the mounting until the gun is facing some convenient eye-bolt at about the same height on ship's structure and then haul the barrel right home by a pul-lift between the muzzle clip and the eye-bolt.

*Note.* Should it be found that the new barrel has no muzzlewell it will be impracticable to use the muzzle clip to haul the new barrel home. In this case tie a wire strap through the bore of the barrel inserting a wooden toggle through the eye at the breech end and hook the pul-lift to the eye at the muzzle end.

- (d) Train the mounting back under the crutch and replace the breech ring in the reverse order to removal.

502

## CIT VI SECTION 5—LIFTING GEAR

### Para 50.

503. The mounting can be lifted for the examination of the centre pivot, the training rollers and roller paths or complete with its base plate as when hoisting it out of the ship by using gear which has been specially designed for this purpose.

The gear consists of a steel **cross beam** from which hang two steel **slings** carrying **saddle pins** at their lower ends.

504. **PREPARATION.**—The following preparatory work must be carried out:—

- (i) remove the cover plates on the top of the shield and expose the holes cut in the shield to allow the lifting slings to pass through the shield.
- (ii) (a) for plain mountings—remove the junction boxes.
- (b) for plain and R P 50 series mountings fitted with safety firing or tel gear—remove the operating lever and gear from R H trunnion pin.
- (iii) disconnect electric cables in ship's boxes and voicepipe (if fitted).

*Then, if the mounting is being lifted for examination of centre pivot, training rollers and roller paths*

- (iv) remove driving pinion bracket and pinion drive to training receiver.
- (v) remove the centre pivot rollers using the forcing screws provided, after first removing the central pin of the drum pump under the mounting and the supporting ring at the underside of the roller bearing.
- (vi) remove the training clips.

*Alternatively, if the mounting is being lifted complete with its base plate:—*

- (vii) remove the 28 hexagon headed holding down bolts  $1\frac{1}{2}$ -in diameter and the 28 three-headed holding down bolts  $\frac{1}{2}$ -in diameter.

## APPLICATION OF THE LIFTING GEAR

505. Having completed the preparatory work for whichever lifting operation is desired, the lifting gear is suspended over the mounting and the saddle pins inserted within the elongated hole cut in each carriage side plate.

In this position it will be found that a **steadying bracket** on each of the slings engages the gusset plate on the carriage and prevents the mounting tilting forward or backward in the slings when it is lifted.

For R P 50 series mountings the lifting slings (which are shorter than those used for the plain mountings) are secured to brackets bolted to the sides of the carriage and positioned further up than the saddle pins for the plain mountings; hence the steadying brackets are not required.

*Note.*—The lifting gear is normally retained in the Dockyard and fitting-out Ports.

(G. 502/64.—Amendment No. 25.)

497 Grease barrel and when conditions (a) and (b) obtain, insert the barrel in the jacket.

Note Both left and right barrels should be capable of being withdrawn and replaced without repositioning the structure.

Add new paragraph 498

498 When the breech ring is replaced, care must be taken that the surfaces where the balance ring overlaps the breech ring are well served with thick graphited grease. Otherwise rust will occur and the breech ring may be difficult to remove at a subsequent occasion.

499-502."

(S 00099/43. A.F.O. P.5/48.)

(Previous amendment No. 11.—A.F.O. P.136/45)

### Plate 23

503. The mounting can be lifted for the examination of the centre pivot, the training rollers and roller paths or complete with its base plate as when hoisting it out of the ship, by lifting gear which has been specially designed for this purpose.

The gear consists of a steel cross beam from which hang two steel slings carrying saddle pins at their lower ends.

504 PREPARATION. The following preparatory work must be carried out —

Paragraph 504. Preparation

(i) Remove the shield

(a) remove both gunnery lamps and capstern

(i) remove the upper plates on the top of the shield and expose the hole-out in the shield to allow the lifting slings to pass through the shield.

ig rollers and roller

(ii) (a) for plain mountings—remove the direction beams

(b) for plain and R.P.30 series Mountings fitted with safety firing switch gear—remove the operating lever and gear from H.M. transmission pin.

After first removing supporting ring at

(C 88061/43. A.F.O. P.21/48.)

LIFTING SLINGS MUST BE USED INSTEAD OF CABLES

(vi) remove the training chain

Alternatively if the mounting is being lifted complete with its base plate —

(v) remove the 28 hexagon headed holding down bolts  $1\frac{1}{2}$  in. diameter and the 28 chevron-headed holding-down bolts  $\frac{1}{2}$  in. diameter

### APPLICATION OF THE LIFTING GEAR

505. Having completed the preparatory work for whichever lifting operation is desired the lifting gear is suspended over the mounting and the saddle pins inserted within the elongated hole cut in the carriage side plate.

In this position it will be found that a **steading bracket** on each of the slings engages the gusset plate on the carriage and prevents the mounting tilting forward or backward in the slings when it is lifted.

Paragraph 505 APPLICATION OF THE LIFTING GEAR

at Ports.

After the slide For R.P.30 series mountings by using slings which are attached to the frame used for the plain mountings are required to enable the mounting to be hoisted out of the carriage and positioned either at the water level for the plain mountings, where the **steading brackets** are not required.

(S 00061/43. A.F.O. P.21/48.)

# APPENDIX I KEY TO LUBRICATION DIAGRAM

## Plate

Position	No.	Total	Type	Location
Ladle	1-4	4	Stuffers	2 on 4 ladle in front
	7-2	6	Stuffers	" " " " " " " "
	13-5	6	Stuffers	4 on 6 ladle in front
Transfer	21-22	2	Stuffers	1 on each side
	23-24	2	Stuffers	1 on each side
	25-26	2	Stuffers	1 on each side
S.A. gear	27-30	4	Stuffers	2 on L.H. side 2 on R.H. side
	31-35	5	Stuffers	1 on L.H. side 4 on R.H. side
	36-40	5	Stuffers	1 on L.H. side 4 on R.H. side
Revolving feed conveyor	41-42	2	Stuffers	1 on L.H. side 1 on R.H. side
	43-44	2	Stuffers	1 on L.H. side 1 on R.H. side
Steering handle	47-48	2	Stuffers	1 on L.H. side 1 on R.H. side
Others	49-52	4	Stuffers	1 on each side 2 on R.H. side
Hose	53	1	Stuffers	1 on R.H. side
	54	1	Stuffers	1 on R.H. side
	55-57	3	Stuffers	1 on R.H. side 2 on R.H. side
	58-60	3	Stuffers	1 on R.H. side 2 on R.H. side
	61-63	3	Stuffers	1 on R.H. side 2 on R.H. side
Worm gear box and training gear	62	1	Stuffers	1 on R.H. side
	63	1	Stuffers	1 on R.H. side
	64-67	4	Stuffers	1 on R.H. side 3 on R.H. side
	68-70	3	Stuffers	1 on R.H. side 2 on R.H. side
	71-72	2	Stuffers	1 on R.H. side 1 on R.H. side
Elevating gear	73-75	3	Stuffers	1 on R.H. side 2 on R.H. side
	76	1	Stuffers	1 on R.H. side
	77-82	6	Stuffers	1 on R.H. side 5 on R.H. side
	83-84	2	Stuffers	1 on R.H. side 1 on R.H. side
	85-86	2	Stuffers	1 on R.H. side 1 on R.H. side
Safety lifting gear	87	1	Stuffers	1 on R.H. side
	88	1	Stuffers	1 on R.H. side
	89-90	2	Stuffers	1 on R.H. side 1 on R.H. side
	91-92	2	Stuffers	1 on R.H. side 1 on R.H. side
	93-94	2	Stuffers	1 on R.H. side 1 on R.H. side
Drive to training receiver	95	1	Stuffers	1 on R.H. side
	96	1	Stuffers	1 on R.H. side
	97-100	4	Stuffers	1 on R.H. side 3 on R.H. side
	101-102	2	Stuffers	1 on R.H. side 1 on R.H. side
	103-104	2	Stuffers	1 on R.H. side 1 on R.H. side
Drive to training receiver	105-106	2	Stuffers	1 on R.H. side 1 on R.H. side
	107	1	Stuffers	1 on R.H. side
	108-110	3	Stuffers	1 on R.H. side 2 on R.H. side
	111	1	Stuffers	1 on R.H. side
	112-113	2	Stuffers	1 on R.H. side 1 on R.H. side
Drive to training receiver	114-117	4	Stuffers	1 on R.H. side 3 on R.H. side
	118	1	Stuffers	1 on R.H. side
	119-120	2	Stuffers	1 on R.H. side 1 on R.H. side
	121-122	2	Stuffers	1 on R.H. side 1 on R.H. side
	123-124	2	Stuffers	1 on R.H. side 1 on R.H. side



## APPENDIX I—continued

Position	No.	Total	Type	Location
Drive to elevating receiver ..	118-119	2	Esots	Bracket supporting elevating receiver.
	120	1	Rotherham	Bracket supporting elevating receiver
	121-122	2	Esots	On pinion gear bracket
	123	1	Rotherham	On pinion gear bracket
	124-125	2	Esots	On intermediate gear bracket
	126	-	Rotherham	On intermediate gear bracket
Interceptor	127-142	16	Tockers others	8 on I H. interceptor 8 on H H. interceptor
Sights		6 y	Esots	R H side.
see plate no	—	4	Rotherham	L H side
	—	2	Springwell	
	—	25 y	Esots	

## APPENDIX II

## ORDNANCE Q.F. 4-INCH MARK XVI

## SCHEDULE OF COMPONENT PARTS OF BREACH AND FIRING MECHANISMS

NUMERATURE	Index No.	NUMERATURE	Index No.
<b>Block, breech</b>		<b>Counterbalance, breech block, Mark II.</b>	
Bolt	1	Block	13
Flush firing hole	2	Spring	64
Screw fixing	3	Washer	85
Yoke	4	Roller	86
Flange screwed	(4 in No.)	Screw with split keep pin	87
Cover inner contact	5	Nut identical with split keep pin	88
Screw securing	6	Spring	70
Screw preserving	(9 in No.)		
Screw preserving	(4 in No.)	<b>Crank, cocking, with rivet</b>	72
Cable	8	Roller	73
Screw fixing	10	Screw securing	74
		Spindle	75
		Nut with split keep pin	76
<b>Contact, inner, breech block</b>		<b>Crank, retracting</b>	77
Bolt	11	Roller	78
Nut	12	Screw securing	79
Nut retaining with split keep pin	13		
Nut terminal	(2 in No.)	<b>Spindle cocking and retracting levers</b>	80
Shank	14		
Roller	15	<b>Lever, cocking</b>	81
Washer insulating	(2 in No.)	<b>Lever, retracting</b>	82
Sleeve insulating	17	Roller	83
Spring	19	Screw securing	84
<b>Contact, outer, breech block</b>		<b>Lever, actuating cocking and retracting levers</b>	85
Bolt	20	Roller	86
Nut retaining with split keep pin	21	Screw securing	87
Nut terminal	(2 in No.)		
Shank	22	<b>Bar, recocking</b>	88
Roller	23	Nut retaining with split keep pin	89
Sleeve insulating	24	Spring	90
Washer insulating	(7 in No.)		
Spring	27	<b>Shaft, recocking</b>	92
<b>Contact, breech ring</b>		Nut with split keep pin	93
Bolt	28	<b>Lever, actuating, recocking bar</b>	94
Nut retaining	29	<b>Lever, safety, intermediate</b>	95
Nut terminal	(2 in No.)	Pin axis	96
Washer insulating	(2 in No.)	Screw fixing	97
Sleeve insulating	32		
<b>Cable, breech block contacts</b>	33	<b>Lever, actuating, recocking shaft</b>	98
Tag inner	34	Roller	99
Tag outer	34A	Pin axis	100
<b>Gun, firing</b>		Spring	101
Body	35	Pin cap	102
Cover	36	Nut with split keep pin	103
Block needle part I	37		
Block needle part II	38	<b>Plunger, firing</b>	104
Screw flange	39	Spring	105
Striker	40	Pin retaining	106
Cable bearing striker spring	41	Roller 4 wide	107
Sear trigger	42	Pin axis long	108
Pin axis	43	Roller 2 1/2 wide	109
Screw retaining	44	Pin axis short	110
Spring	45		
Plunger	46	<b>Lever, safety, left gun</b>	111
Plate retaining	47	<b>Lever, safety, right gun</b>	112
Plunger retaining	48		
Needle	49	<b>Levers, safety, left and right guns</b>	
Nut	50	Plunger with split keep pin	113
Bush insulating	51	Head	114
Washer insulating	52	Spring	115
Piece contact	53	Screw retaining	116
Bush insulating	54		
Spring striker	55	<b>Bar, firing, with split keep pin</b>	117
Spring, needle block	56	Spring	118
Catch		Plunger	119
Lever	57		
Pin ledge	58		
Spring	59		
Plug	60		
Pin retaining	61		
Plunger	62		

See following pages for drawings of these component parts

## APPENDIX III

## LIST OF GUN MOUNTING SPARE PARTS TOOLS AND ACCESSORIES

"A" spares denote spare parts per mounting.

"C" spares denote spare parts per ship.

"D" spares denote base spares stored at Dockyards, Repair Establishments, etc.

Drawing No.	Item No.	Article	"A"	"C"	"D"
<b>BEARINGS, ROLL AND ROLLER</b>					
<b>Revolving Gear</b>					
			<i>Rev. Sds</i>		
			<i>Ind. Sds</i>		
			<i>Spares</i>		
N 5182A	3	Thrust Bearing for Worm Shaft	13 1/2 1 1/2		1
	4	Ball Bearing for Worm Shaft	13 1/2 1 1/2		1
	6	Ball Bearing for Worm Shaft	13 1/2 1 1/2		1
	12	Ball Bearing for Worm Shaft and Bevel Wheel Shaft	13 1/2 1 1/2		2
	13	Ball Bearing for Bevel Wheel Shaft	13 1/2 1 1/2		1
N 5183	6	Roller Bearing for Pinion Shaft	13 1/2 1 1/2		1
	7	Roller Bearing for Pinion Shaft	13 1/2 1 1/2		1
	15	Ball Bearing for Pinion Shaft	13 1/2 1 1/2		1
N 5183	3	Ball Bearing for Support Bracket	13 1/2 1 1/2		2
<b>Training Gear</b>					
N 5140	4	Roller Bearing for Pinion Shaft	13 1/2 1 1/2		1
	7	Roller Bearing for Pinion Shaft	13 1/2 1 1/2		2
	4	Thrust Bearing for Pinion Shaft	13 1/2 1 1/2		2
N 5147	12	Ball Bearing for Worm Shaft	13 1/2 1 1/2		2
	15	Thrust Bearing for Worm Shaft	13 1/2 1 1/2		2
N 5160	6	Ball Bearing for Worm Shaft	13 1/2 1 1/2		1
	7	Ball Bearing for Intermediate Bevel Wheel Shaft	13 1/2 1 1/2		1
N 5161	4	Ball Bearing for Intermediate and Bevel Wheel Shaft	13 1/2 1 1/2		2
N 5161	4	Ball Bearing for Bevel Wheel Shaft	13 1/2 1 1/2		1
N 5164	3	Ball Bearing for Handle Spindle	B.R.L. 1 1/2		2
<b>Trunnions</b>					
N 5120	7	Roller Bearings for Trunnion Pins and Keys			2
N 5138	2	Thrust Bearing for Trunnions			2
<b>Drives to Elevation and Training Recovers</b>					
N 10913	7	} Ball Bearings	B.R.L. 1 1/2		10
N 10914	4				
N 10915	4				
N 10916	4				
N 10917	4	Ball Bearing	B.R.L. 1 1/2		1
N 10918	4	Ball Bearing	B.R.L. 1 1/2		1
<b>Outer First Bearing Assembly, comprising—</b>					
N 10925	3	Inner Roller Race Bush			1
	2	Outer Roller Race Bush			1
	4	Retaining Ring for Roller Cage			1
	5	Upper Roller Cage			1
	6	Lower Roller Cage			1
	8	Washers for Upper and Lower Roller Cage			8
	9	Washers for Distance Piece			8
	10	3/8 diameter countersink Screws for Retaining Ring			8
	11	Rollers			40
<b>Supplies</b>					
N 5162	2	Leather for Recoil Cylinder		2	
N 5163	10	Leather for Recoil Cylinder		4	
N 5164	7	Leather for Intermediate Piston		4	
	11	Leather for Intermediate Stuffing Box		2	
<b>Trunnion Bearings</b>					
N 5130	3	Adjusting Washer (to accompany the set of Belleville Washers shown under Springs)			2



## APPENDIX III—continued

Drawing No.	Item No.	Description	A	C	D
<b>ELEVATING GEAR</b>					
<b>Set of Friction Discs, comprising—</b>					
N 5179	1	Friction Discs Steel	—	—	8
	3	Friction Discs (Inmetal)	—	—	0
	6	Adjusting Washers to accompany the set of Belleville Washers shown under Springs	—	1	—
<b>Firing Circuit</b>					
		Firing cables with special fittings only	—	1 set	—
		Interconnector H A Mark IV complete right-hand	—	1	—
		Interconnector H A Mark IV complete left-hand	—	1	—
<b>Joint Rings</b>					
N 5172	4	Joint Ring for Recd. cylinder (copper)	2	—	—
	24	Joint Ring for Recd. cylinder (white metal)	2	—	—
N 5171	4	Joint Ring for Recd. cylinder (white metal)	2	—	—
N 5107	8	Joint Ring for Intake (white metal)	2	—	—
<b>Recd. Cylinder</b>					
N 5172	14 19 & 20	Air Valve	1	—	—
	4	Drain Plug	—	1	—
N 5173	2 3 & 4	Control Rod with Nut and Pin for Ships with Mark XX Guns	—	1	—
	6 & 7	Control Shuttle Valve with Bearing Rings	—	1	—
<b>PISTON COMPLETE, COMPOUND</b>					
	1 & 4	Platen Rod with 3 Bearing Rings	—	—	2
	10	Split Pin for Platen Rod Nut	—	—	2
	11	Air Cocks for Platen Rod	—	—	2
N 5172	2 12 13 & 14	Recd. cylinder Ring with Locking Rings etc.	—	—	2
	3	Nut for Platen Rod	—	—	2
	2 & 23	Collar with Set Screw for Platen Rod	—	—	2
<b>Recuperator Cylinder</b>					
N 5161	14	Drain Valve	1	—	—
N 5162	8 7 & 8	Ring for Recuperator with Nut and Split Pin	—	—	2
N 5163	4 9, 10 & 11	Two Cords with Nuts and Split Pin complete	—	—	2
		Adapter to enable Outside Hose with 1 1/2 in. female connection to be used on existing 1 1/2 in. Male connection on Mounting when charging Recuperator	—	1	—
		Pressure Gauge Plate No 2513 or 1667 (Dials to be marked 4 in. H A Twin XX and 4 in. H A XX Mountings and red line marker at 90 lbs sq in)	—	2	—
N 10855	9 10, 11 & 12	Adapter for Pressure Gauge complete with Joint Ring	—	3	—
<b>Semi-Automatic Gear</b>					
N 22124	2	Camshafting Breech Mechanism, Left	—	1	—
N 2205	3 4 & 5	Camshafting Breech Mechanism, Right	—	1	—
N 2202	1 2 3 & 6	Crank and connecting Breech Mechanism, complete with Bushes and Pins	—	1	—
N 22125	7 8 & 9	Crank Arm modified to N 22 833 complete with Bush, Washer	—	1	—
N 22126	10 11 & 12	Friction Washer, Roller and Bush	—	—	—
N 2202	13	Plunger, Crank Arm	—	—	1
	14	Spindle, Buffer, Crank Arm	—	—	1
	15	Wash securing Buffer	—	—	1
N 22127	16 17 & 18	Nut securing Buffer Spindle	—	—	1
	19 & 20	Roller and Bush	1	—	—
<b>Semi-Automatic Gear - Reduced Charge</b>					
N 5202	3"	Screw fixing S N 22113	2	—	—
	6"	Washer for S N 22113	2	—	—
	7"	Nuts securing S N 5202	2	—	—
	8"	Knock down Nipple	2	—	—

## APPENDIX III—continued

Drawing No.	Item No.	Articles	"A"	"C"	"D"
<b>FIFTH COMPLETE, COMPLETE</b>					
<b>Semi-Automatic Gun—Reduced Charge</b>					
N 22126	37	Friction Washer for Roller	2		
	40	Roller	2		
	41	Brush for Roller	2		
N 22413	1	Cam Left hand short recoil	1		
	2	Cam Right hand short recoil	1		
	3	Crank Arm Left hand short recoil	1		
	4	Crank Arm Right hand short recoil	1		
	5	Push for 3 and 4 N 22413	2		
N 10950		Range Dial—reduced charge 1 set 3 dials	1		
Items marked thus * to be delivered assembled					
<b>Sighting and Sight Testing Gear</b>					
Set of Sights complete with Dials to suit Mark XVI* guns					
Cables with special End connections for Night Sight and Illumination					
N 10951		Photo Telescope Holder—set X	1		
N 0743		Photo Telescope Holder—set X (for ships of new construction)	2		
		Photomicroscope for Gunmaster	1		
<b>Spring</b>					
N 8150	0	Hellville Washer for Trunnion Bearing	4		
N 8142A	18	Spring for Firing Key	1		
N 5 76	4	Spring for Elevation and Depression Stud	2		
N 5 08	6	Spring Valve Adapter (for gun)	2		
N 10145	3	Spring Drive to Trunnion	1		
N 10142	10	Spring Drive to Elevator	1		
N 5 48	5	Hellville Washer for Trunnion Washer	3		
N 5 79	7	Hellville Washer for Trunnion Washer	3		
N 0884	13	Spring for Cam Roller Shaft	2		
N 8200	1	Spring Catch Change	2		
N 8201	11	Spring Catch Arm Change	2		
	12	Spring for Bolter N 5 48	2		
N 1 444	7	Spring for Bolter (containing intercept)	4		
<b>Tools</b>					
N 824	1	Spanner for Training Stud Spindle	1		
	2	Spanner for Training Stud Spindle	1		
	3 & 4	Spanner for Training Stud Spindle	1		
	5	Spanner for Training Stud Spindle	1		
	6	Spanner for Training Stud Spindle	1		
	7	Spanner for Training Stud Spindle	1		
	8	Spanner for Training Stud Spindle	1		
	9	Spanner for Training Stud Spindle	1		
	10	Spanner for Training Stud Spindle	1		
	11	Spanner for Training Stud Spindle	1		
	12	Spanner for Training Stud Spindle	1		
	13	Spanner for Training Stud Spindle	1		
N 10920	1	Spanner for Training Stud Spindle	1		
	2	Spanner for Training Stud Spindle	1		
	3	Spanner for Training Stud Spindle	1		
	4	Spanner for Training Stud Spindle	1		
	5	Spanner for Training Stud Spindle	1		
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	7	Spanner for Training Stud Spindle	1		
	8	Spanner for Training Stud Spindle	1		
	9	Spanner for Training Stud Spindle	1		
	10	Spanner for Training Stud Spindle	1		
N 5213	1	Spanner for Training Stud Spindle	1		
	2	Spanner for Training Stud Spindle	1		
	3	Spanner for Training Stud Spindle	1		
	4	Spanner for Training Stud Spindle	1		
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	96	Spanner for Training Stud Spindle	1		
	97	Spanner for Training Stud Spindle	1		
	98	Spanner for Training Stud Spindle	1		
	99	Spanner for Training Stud Spindle	1		
	100	Spanner for Training Stud Spindle	1		



## APPENDIX IV

## DETAILS AND NUMBERS OF MODIFICATIONS TO MOUNTINGS

Serial numbers have been allocated to the modifications authorised to the 4-in. H.A. Twin. Mark XIX Mountings including the R.P. 50 mm.

Details of future modifications with their modification numbers will be promulgated as amendments to this handbook.

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*Require flow of mountings should be forwarded to Admiralty as each modification is completed*  
 NOTE The letters "P" & "RP" below the modification number indicate that the modifications are applicable to PLAIN Mountings & R.P. series Mountings respectively. All other modifications are applicable to both plain and R.P. series Mountings.

Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 1042/37	<b>L.A. GEAR</b> Mountings Nos 14, 15, 16 to 19 and 21 to be modified as shown on diagram	A.F.O. Diagram 42 27			Ship's staff and dockyard	
A.F.O. 2103 37 2274 37 2305 39 C.A.F.O. 2612 38	<b>L.A. GEAR</b> Fit modified arms and rollers <b>RECOIL PISTON RODS</b> Type B (10 fitted as standard. Existing type A to be modified to type B) NOTE A.F.O. 2103 37 and 2274 37 and C.A.F.O. 2612 38 were cancelled by A.F.O. 2412 39 and reinstated by A.F.O. 1485 39	A.F.O. Diagram 111 27	A and A	On demand	Dockyards	2
A.F.O. 2606/37	Fit hydraulic <b>TRAINING BUFFER</b> and separate housing device. Dry. No. N 22343.		As. and As.	On demand	Dockyards	3
A.F.O. 1025 38	<b>SIGHTING GEAR</b> Fit instruction plate N 3233		Defect		Dockyards and ship's staff	4
A.F.O. 2460 38	<b>INTERCEPTION</b> Herringbone link and pin 14 N 1027 replaced by pin for link line in D N 10923 and bearing plate 12 N 1146, fitted	A.F.O. Diagram 65 38	Defect		Ship's staff	5
C.A.F.O. 2403 38	<b>I BARRAGE SIGHTS</b> To be fitted <b>II SIGHT PORTS</b> To be enlarged. New covers to be fitted to Dry. No. N 3307 as applicable to Mountings Reg. Nos 2 to 13 inclusive and 15 to 27 inclusive. See also A.F.O. 1042 41 and A.F.O. 2603 42	C.A.F.O. Diagram 66 38	As. and As.	On demand	Dockyards	6
A.F.O. 2701 38	<b>TRAINING BEARING RECEIVER DRIVES</b> To be fitted over 4 N 10914 to be fitted	A.F.O. Diagram 97 38	As. and As.		Dockyards	7
A.F.O. 1880 39	<b>RUN OUT CONTROL RODS</b> To be fitted. Jugs Nos 2, 3, 8 to 19, 24 to 31, 36 to 56, 64 to 87, 104 to 120 and 316. Particular error to be corrected.	A.F.O. 98 39	Defect		Ship and dock yards	8
A.F.O. 2497 38	<b>BALANCE WEIGHTS</b> To be fitted	A.F.O. Diagram 136 39	Defect		Dockyards	9
A.F.O. 2610 39	<b>PERCUSSION FIRING GEAR</b> length of pump lever reduced and palm piece modified. See also A.F.O. 2608 39	A.F.O. Diagram 184 39	A. and A.		Dockyards	10
A.F.O. 2877 39	<b>LOADING LIGHTS</b> Alternative position for loading light.	A.F.O. Diagram 163 39	Optional			11
A.F.O. 2606/39	<b>PERCUSSION FIRING GEAR</b> . To be fitted (i.e. no damage not already fitted (as enumerated)).	Dry. No. N 24303 and N 21906A	A and A	Supplied without detached	Dockyards	12



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 553/40	1. <b>BALANCE RING</b> Modifications to facilitate the withdrawal of loose bands. 2. <b>RECOIL CONTROL ROD</b> Modifications to facilitate the withdrawal of loose bands. 1. Holes for removal of breech ring securing screws. 2. Hacksaw on end of control rod. 3. N 5172 to be cut off and four 0.34-in. dia. (6-tee) drilled for spacers. N 3241. See also C.A.F.O. 830/50 and 004/20.	A.F.O. Diagram 83/40	A and A		1 Dockyard 11 Ship's staff	1
A.F.O. 2368/40	<b>S.A. GEAR</b> Holes for installation of A & M of brackets. N 10585 and N 10586 to be fitted with interchangeable of full size required charge valves, etc.	A.F.O. Diagram 62/40			Ship's staff	14
A.F.O. 2602/40	<b>INTERCEPTOR</b> Fitting of A and M (transposed). Wiring (see notes).				Ship's staff	15
A.F.O. 2724/40	<b>PLATFORMS NORMAL TYPE SHIELD MOUNTINGS ONLY</b>	A.F.O. Diagram	A and A	As required	Dockyard	16

Insert details of Modification No. 111:-

A.F.O. 2570/50	<b>METAPHNE STARTERS MARK TWO</b> — Remove the starter together with its associated wiring and mounting bracket from all Metaphne Starters Mark TWO fitted on the above gun mountings. The remaining hole should be blanked off.	Drawing Nos. E2031760 E2031771	-	-	Ship's staff, Shore Establishments and Gunnery Equipment Depots	111
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(Amendment No. 29.)

C.A.F.O. 40	<b>S.A. GEAR</b> Reissue change valve 1 and 2 N 27413 and 27414 to enable valves to be fitted without retaining gun back.				Manufacturer or dock yard with Admiralty approval	14
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A.F.O.	<b>FITTING OF 870 TRAINING STOP</b>	A and A			Dockyard	8
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Page 57 (inserted by A.F.O. P.559/48)

(Insert Modification No. 191 Column 2 Add)

"The pawl retaining catch 1. Drawing No. N.31385 must be fitted at the same time"  
(G 0620/60—A.F.O. P.255/60.)

Page 57 (as inserted by A.F.O. P.559/48) Modification No. 24 Second column. Add Extended  
Type shield mountings on y

A.F.O. 057/41	<b>BARRAGE LIGHTS</b> Approved form of 200 watt barrage light to be fitted. Drawing No. N 30905. N 30906 and A. See also A.F.O. 2697/45 and C.A.F.O. 2403/34.	A.F.O. Diagram 113/41			Ship's staff Dockyard	21
A.F.O. 2368/41	<b>BALANCE RING</b> Fitting of Deviser to the gun mountings in position of breech ring.	A.F.O. Diagram 204/41			Ship's staff	22
A.F.O. 2602/41	<b>INTERCEPTOR</b> Fitting steel stop piece, items 10 and 11 N 11493.	A.F.O. Diagram 337/41			Ship's staff	23
C.0726/41	<b>PLATFORMS</b> Addition of drain holes to items 13 and 14 N 21805A. 8 to No. 2 5 dia.				Manufacturer or dock yard with Admiralty approval	24
C.4008/41	<b>SHORT PORT COVERS</b> Drain holes added to items 4 N 22830.					25
G 01311/41	<b>RECOCKING TOOL</b> Stowage position added. N 10924.					26

Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 19, 42 A.F.O. 22, 42	<b>RECOIL CYLINDERS</b> : Instructions state 2, N 5 0A. modified re filling instructions				Ship's staff	27
A.F.O. 28, 42	<b>CARRIAGE</b> To fit additional stiffening to Drawing No. N 32221. See also N 5 99 N 10814, N 10834. <b>SIGHT PISTONS</b> Fit over the pistons as necessary. See also A.F.O. 5425 44.	A.F.O. Diagrams 152 42 (1 and 2)	A and A		Dockyards and depot ships	28
A.F.O. 337, 42	<b>SHIELDS AND PLATFORMS - EXTENDED SHIELD TYPE MOUNTINGS ONLY</b> Modifications to ship platforms and balance weight for H.M. Ships - number listed. Aurora - Birmingham - Sheffield - Liverpool - and Manchester and for future ships but also as required to draw the Nos. N 26643 and N 26643A.	A.F.O. Diagrams 182 42 and Drawing GR 6906	A and A	(On demand)	Dockyards and repair establishments	29
A.F.O. 41, 42	<b>RECOIL OPERATOR'S ROOM - THROTTLE</b> Instructions for drawing No. N 34031.				Ship's staff or depot ship as required	30
<i>Cancelled and replaced by Memorandum No. 55 dated 28.3.48</i>						
A.F.O. 460, 42	<b>APRON PLATES</b> To be fitted to the front of the shield	A.F.O. Diagram 263 42	At first available opportunity	Plans to be demanded	Ship's staff	31
A.F.O. 518, 42	<b>SAFETY TRAINERS SIGHT</b> Fitting of safety trainers sight to be done as required. A.F.O. 1617 39 to be cancelled.					32
A.F.O. 540, 42	<b>BLAST RACE</b> : Existing blast race to be replaced by modified type in Drawing No. N 34931 and when the former are unsatisfactory or defective	A.F.O. Diagrams 301 42			Ship's staff with assistance of dockyards if necessary	33
O.013476/42	<b>ELEVATING LIMIT SWITCH</b> Overhaul of gear spring in assembly mounted in items 11 12 14 15 16 42 and 43 of original Drawing N. N 33052 cancelled and replaced by items 44 to 46 of N 33053				Manufacturers or dockyards with Admiralty approval	34 R.P.
O.16048, 42	<b>ELEVATING GEAR</b> : Thrust bearings 3 and 4 N 32454 added to hand screw shaft assembly				Manufacturers or dockyards with Admiralty approval	35 R.P.
A.F.O. 28 42	<b>SIGHT PISTON SHAFT</b> Extension piece and other details items 1 to 4 N 24342 to be fitted to lubricator in gear case 1 N 14937	A.F.O. Diagrams 2 42			Ship's staff	36
A.F.O. 2274 42	<b>SAFETY PERCUSSION FIRING GEAR</b> Safety percussion gear to be fitted to Drawing N. N 34215; Drawing Nos. N 10814 and N 10834. (Note: See) NOT APPLICABLE TO MOUNTINGS FITTED WITH SAFETY FIRING SWITCH GEAR TO DRAWINGS No 4768 O B	A.F.O. Diagrams 109 42 (1-3)	A and A		Ship's staff with dockyards and depot ships	37
A.F.O. 2884 42	<b>TRUSSING BEARINGS</b> Fit modified crumpling bearing assembly to Drawing No. N 29904 and N 30603. This order cancels A.F.O. 2500 42 and 4062 42		A and A	To be demanded	Dockyards	38
A.F.O. 3680, 42	<b>SHIELD</b> Access hole to be cut in shield for mountings fitted with F Mark II Elevating receivers and/or Pattern No. 20 Training Receivers (small type modified) Drawing No. N 10814 and GR.6357	A.F.O. Diagrams 332 42			Ship's staff	39

Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 1893/49	<b>BARRAGE SIGHTS + MOUNTINGS FITTED WITH TYPE F MARK II ELEVATION RECEIVER</b> Barrage sights on L.H. were to be repositioned to avoid wooding. Drawing No N 20606A, OR 6136.	A.F.O. Diagram 160/49(1-3)			Ship's staff	40
A.F.O. 6435/49	<b>ELEVATING GEAR HAND POWER CLUTCH</b> A diagram indicating to be provided. P.T. Drawing N 33035.	A.F.O. Diagram 286/49			Ship's staff	41 R.P.
G.O.10781/49	<b>HOUSING STOP</b> Modification to make the stop standard for all types of construction in items 1 to 4 N 23405; items 5 and 6 N 10925A modified item 10, N 23403 added.				Manufacturer or with Admiralty Approval	42
G.O.14480/49 April 1949	<b>SAFETY FIRING SWITCH OPERATING GEAR</b> To be fitted to all mountings for future manufacture to Drawing N 47620/49. Recommended modifications as shown on Drawings N 22004, N 24603, N 33721, N 10416, N 20334, N 33044, N 33769, N 24840* (* for R.P. mountings only). Note: When this gear is fitted the palm lever interlock for percussion firing should also be fitted see A.F.O. 2438/49.				Manufacturer or with Admiralty Approval	43
July 1949	<b>SLIPPING CLUTCHES</b> Elevating and Training items 33 and 34 N 33726 added see Drawings N 33033 and N 23032.				Manufacturer or with Admiralty Approval	44 R.P.
October 1949	<b>TRAINING LOCK SWITCH GEAR</b> Adjustable gear. Items 0 and 10. N.3247; modified.				Manufacturer or with Admiralty approval	45 R.P.
September 1949	<b>TRAINING BASE</b> Inspection hole at R.H. side of training base and cover added - N 20811A.				Manufacturer or with Admiralty approval	46 R.P.
G.O.3446/49	<b>JOYSTICK CONTROL COLUMN</b> Support bracket N 34447 replaced by N 36187.				Manufacturer or with Admiralty approval	47 R.P.
December 1949	<b>JOYSTICK HANDLE</b> Handle of locking pin N 34847 lengthened.				Manufacturer or with Admiralty approval	48 R.P.
G.O. 4050/49	<b>ELEVATING GEAR</b> Bearing on security for worm wheel shaft. Various alterations and modifications shown in items 2 of Drawing No N 33034.				Manufacturer or with Admiralty approval	49 R.P.
A.F.O. Page 59.	<b>SEMI PERMANENT STOP</b> For use. Max. forward N 51. Do not and substitute in column 2.	A.F.O.	A and A		Ship's staff depot ships and	50 P.
	<b>LOCAL CONTROL OFFICERS SIGHT</b> To be fitted in 100 mm. Barrage sight. (ANNEX BE BARRAGE SIGHTS MOUNTED NOS WITH ROCKET FLARE LAUNCHERS AS FITTED TO DRAWING N 10416) which the gunners are fitted as shown on Drawing No G 226. Drawings Nos N 36078F N 36079F N 36080.		A and A	T or demanded	Ship's staff and dockyards	51

Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 2594/44	<b>SHIELD</b> Holes to be cut in side of sheets for access to gun driving motors and covers to be fitted. Note: Both sides for R.P. 60 Mountings. L.H. side only for R.P. 51 and R.P. 52 Mountings.	A.F.O. Diagram 254/44	—	—	Ship's staff	55 R.P.
A.F.O. 4742/44	<b>SIGHT TRUNNION BRACKET</b> . Additional ground supply to be fitted at the bottom of the sight trunnion bracket over R.H. side only. Drawing Nos. N 10035 and N 0035.			—	Ship's staff	56
A.F.O. 4804/44	<b>HAULING BACK GEAR</b> Muzzle adapt or push. Gun N 10923 to be made for use with guns with parallel gunwale.	A.F.O. Diagram 201/44	Defect		Ship's staff and dockyard	55
A.F.O. 5306/44	<b>RECEIVER DRIVES</b> Elevating and training Modification to Venier couplings.	A.F.O. Diagram 329/44		—	Ship's staff	58
A.F.O. 5425/44	<b>SIGHT AND ELEVATION RECEIVER DRIVE PINION</b> Instructions for fitting and supply of oversize pinions in conjunction with A.F.O. 2852/43 (canceling A.F.O. 4492/43).			To be demanded		57

Page 60, as inserted by A.F.O. P. 448/45. Modification No. 58. Second column 44d. Normal type shield mountings only.

(G. 04090.50 A.F.O. P. 9-51)

G. 0894/44	<b>SHIELD</b> : Handle 71 N 10015 added.	—		—	Manufacturer or Dockyard with Admiralty approval	59
G. 7295/44	<b>SIGHT PORT COVER</b> If there be adapt or adjust to hinge (note 3, N 15307)				Manufacturer or Dockyard with Admiralty approval	60
G. 04010/44	<b>ELEVATING HANDLES</b> Locking pin, etc. (note 2, 1. 33 N 10877 added for securing handles).				Manufacturer or Dockyard with Admiralty approval	61
G. 02044/44	<b>BATTERY LUBRICATION</b> Fitted 1. Drawing N 36182 for future manufacture.			—	Manufacturer or Dockyard with Admiralty approval	62
March, 1944 G. 0487/43	<b>SLANT SCREEN GEARS</b> Elevating and training gear off side (cancelled - Drawing Nos. N 36028, N 36029A, N 36028, N 36029, N 36102, N 36102A).				Manufacturer or Dockyard with Admiralty approval	63 R.P.
August, 1944	<b>RESETTER BOX</b> Elevating gear. Screws plus N 36166 lengthened and washer 14 N 36 66 added to prevent blocking through. Coarse. Fine mountings only.				Manufacturer or Dockyard with Admiralty approval	64 R.P.
C.A.F.O. 1603/45	<b>LOUDSPEAKER FOR ARMAMENT BROADCAST SYSTEM</b> . Loud speaker to be positioned inside the tank to Drawing No. N 39392.	C.A.F.O. Diagram 180/45	A. and A.	—	Ship's staff	65
A.F.O. 3175/45	<b>ELEVATING GEAR REDUCTION GEAR BOX</b> Fit and level plug at platform level and fit instruction plate. Items 17 to 22, N 22470 and 21 and 22, N 22051.	A.F.O. Diagram 220/45	Defect	—	Ship's staff	66 R.P.



Authority	Description	Diagram	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 3438/45	<b>FREQUENCY FIRING GEAR</b> For interlock to palm lever Drawing No. N 30394 N 30391 ONLY APPLICABLE TO MOUNTINGS FITTED WITH SAFETY FIRING SWITCH OPERATING GEAR.	A.F.O. Diagram 245 45 (encl 2)	A and A		Ship's staff and dockyard	67
A.F.O. 4890/45	<b>FRICTION DISC COUPLINGS</b> Also a big and Training Lever 15 N 33500 and size of used. etc. items N 31 100 32 N 33500 to be used for checking the adjustment of the setting.	A.F.O. Diagram 222 43			Ship's staff	68 R.P.
A.F.O. 5467/48	<b>BRACKET FOR REMOVAL OF KREECH BLOCK</b> Bracket to be made to facilitate the removal of the kreech block 13 N 3343	A.F.O. Diagram 331 43			Ship's staff	69
G 2574/48	<b>RECOVERATOR OLAND NUT</b> Nut top 3 N 510, modified by producing the lower part in 5 3-m. and increasing the length of same from 0.1 in. to 0.35 in.				Manufacturer or Dockyard with Admiralty approval	70
Authority 1045	<b>CORRECTOR GEAR FOR FOLLOW-THROUGH TRANSMITTERS</b> Arrives hole and items 10 5 31 and 32 Drawing No. N 33342 added.				Manufacturer or Dockyard with Admiralty approval	71 R.P.
A.F.O. 424-48	<b>KREECH WORKERS FIRING PUSH</b> To be fitted to messengers with safety firing switch gear only (N 33987)	A.F.O. Diagram 38 46	A and A	To be dismantled	Ship's staff	72
A.F.O. 8001/48	<b>CORRECTOR GEAR FOR FOLLOW-THROUGH TRANSMITTER</b> Wiring connections and engraving on items 17 8 22 and 23 of N 33341 to be reversed		Defect		Ship's staff	73 R.P.

Page 61 as inserted by A.F.O. P. 339 48) Modification No. 74 R.P. Second column. A44 Coarse  
for mountings only

(. 01086 50 A.F.O. P. 331)

A.F.O. 1944 47	<b>CRADLES OF CANADIAN MANUFACTURE</b> To rectify discrepancies manufactured cradle legs where necessary Drawing No. N.6168A	A.F.O. Diagram 29 47	Defect		Dockyard and Depot ships	74
A.F.O. 1816/47	<b>KREECH WORKERS LOADING PLATFORM</b> To be fitted to PLAIN MOUNTINGS ONLY Drawing No. GH 7381).	A.F.O. Diagram 80 47	A and A		Dockyard and Depot ships	75 P
A.F.O. 1803.47	<b>HOUSING STOP BRACKET</b> Ship piece to be fitted items 14 and 15 N 33005 or 16 and 17 N 33057)	A.F.O. Diagram 79 47	Defect		Ship's staff	77
A.F.O. 1804/47	<b>67° TRAINING STOP GEAR</b> To be warning and instruction	A.F.O. Diagram	Defect		Ship's staff	78 R.P.
A.F.O. 1837 49	Fitting of light range stop for star shell control.	A.F.O. Diagram 47 49(1-3)	Defect	To be dismantled	Ship's staff	81
A.F.O. 2899 49	Fitting of safety firing gear to kreech Platform	A.F.O. Diagram 47 49(1-3)	A and A	To be dismantled	Dockyard	82
A.F.O. 2673/50	<b>SHIELD</b> For work on the ship's hull and the hull's place	Ref. sheet No. N 11415	Defect		Dockyard and Depot ships	83
A.F.O. 2673/50	<b>LIFTING GEAR</b> For work on the ship's hull and the hull's place	Ref. sheet No. N 23544	Defect		Dockyard and Depot ships	84

*Cancelled & replaced  
modification No 90 A.F.O. P. 10153*

Order No.	Description	Diagram No.	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 1872/50	<b>RECOIL CONTROL RING</b> Modified to meet the requirements of the new design and replaces modification No. 1872/50.	Drawing No. N 5173A	Defect	To be demanded	Ship's staff	85
A.F.O. 1872/50	<b>INSTRUCTION PLATE</b> IN 5170A. To be modified in order to be compatible with the addition of the new design of the O.M. 13. The new design of the instruction plate must be carried out in accordance with the new design.	Drawing No. N 5170A	Defect	To be demanded	Ship's staff and dockyard	86
A.F.O. 1872/50	<b>570 TRAINING STOP GEAR GUARDS</b> To be modified in order to be compatible with the new design of the guards.	Drawing No. N 57003 Sheet 2	Defect	To be demanded	Ship's staff and dockyard	87
A.F.O. 1872/50	<b>570 TRAINING STOP GEAR TRAINING INDICATOR</b> To be modified in order to be compatible with the new design of the indicator.	Drawing No. N 57007	Defect	To be demanded	Ship's staff and dockyard	88
A.F.O. 1872/50	<b>CHADLER</b> To be modified in order to be compatible with the new design of the chadler.	A.F.O. Diagram No. 71/50	Defect	To be demanded	Dockyard and Ship's staff	89
A.F.O. 1872/50	<b>LUBRICATION</b> New standard to be adopted in order to be compatible with the new design of the lubrication system.	Drawing No. N 5130A	Defect	To be demanded	Ship's staff	90

(C. 5518/48.— Amendment No. 24)

Annually checked by Ship's staff on 1st of July 1950	<b>ROCKET FLARE LAUNCHERS</b> To be modified in order to be compatible with the new design of the launchers.	Drawing No. N 4413	A and B	To be demanded	Dockyard and Ship's staff	91
A.F.O. 1872/50	<b>INTERFUSERS</b> To be modified in order to be compatible with the new design of the interfusers.	Drawing No. N 4414	Defect	To be demanded	Ship's staff and Dockyard	92

(C. 5518/48.— Amendment No. 24)

Order No.	Description	Diagram No.	Category of modification	Supply of material	By whom to be done	Modification No.
A.F.O. 554/53	<b>TRAINING HAND-POWER CLUTCH</b> - for use for training ship's staff with Dockyard assistance	A.F.O. Diagram 1c 43 Drawing	Defect			92 H.P.

Page 63. After entry relating to Modification No 93 R.P. insert

A.F.O. 2788/53	<b>PALM LEVER INTERLOCK</b> - Thumb lever to be modified ON A ALPHADLE T.O. MOUNTINGS WITH SAFETY F RING SWITCH GEAR Handbook Plate 24A	A.F.O. Diagram 45 53 Drawings Nos N 98090, N 28090A	Defect	-	Ship's staff with dockyard assistance	94
A.F.O. 3892/54	<b>EASIER FIRING SWITCH GEAR</b> - To be fitted with additional lubricator and oil in N. 11's his pipe to inaccessible position in points	A.F.O. Diagram 4 54 Drawings Nos N 36182, N 36 82A, 71204 B, 71204C B	Defect	Flexible pipe to be demanded	Ship's staff with dockyard assistance	95
	Stronger spring to be fitted if found necessary			To be demanded		95A
Admiralty G. 63985, 91 dated 28th March, 1952	<b>SHIELD</b> - To fitting bracket to be fitted for 900 M.V. set	Drawings Nos N 10815, N 51461	A and A	A and B	Dockyard	96
A.F.O. 9-3-53	<b>CARRIAGE</b> - Gun plate 7 510834 to be set away if necessary to position	Drawing N 10834	Defect		Ship's staff and dockyard	97
A.F.O. 1570/53	<b>BEAR CANVAS COVER</b> - Securing and to be fitted at base of mounting	A.F.O. Diagram 59 53	Defect		Ship's staff with dockyard assistance	98

Admiralty G. 63985, 91 dated 28th March, 1952	<b>PARTITION SHIELD</b> - To be fitted between gun's bracket and mounting sample to be provided	Drawings Nos N 52462, N 10808 rev	A and A	S.S. for cranes A and others	To be demanded. Ship's staff report ship and Dockyard assistance appropriate	99
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Amendment No 97

Admiralty Letter G. 68014, 81 dated 28th April, 1952	<b>SHIELD</b> - Fit boxes for theodolite platform.	Drawings Nos N 10815, D.N.O. 8558	A and A		Dockyard	101
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Admiralty G. 4444 58	<b>PORTABLE PLATE BETWEEN PLATFORM</b> - Fitted on R. 51 and H. 52 mountings mounted on raised platform.	Drawings Nos N 59431 A, DEY MED 59207	A and A	(classification A)	Dockyard	102 R.P.
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Amendment No. 97

dated 28th November, 1955	certain ships	BLACK SWAN class	G. 5351 G. 424			103
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(G. 6391/53.—Amendment No. 26.)

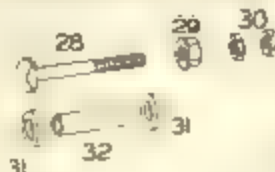
(Previous amendment No. 25. A.F.O. P.274/53.)



**SAFETY LEVER**  
LEFT SIDE



**BREECH RING CONTACT**

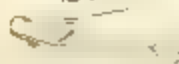


**BREECH BLOCK**



**BM LEVER LATCH  
& CATCH BAR**  
LEFT SIDE

164



4

SA

OF



142

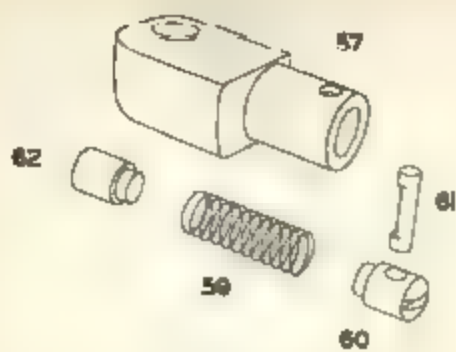
143

**INNER & OUTER BREECH BLOCK CONTACTS**

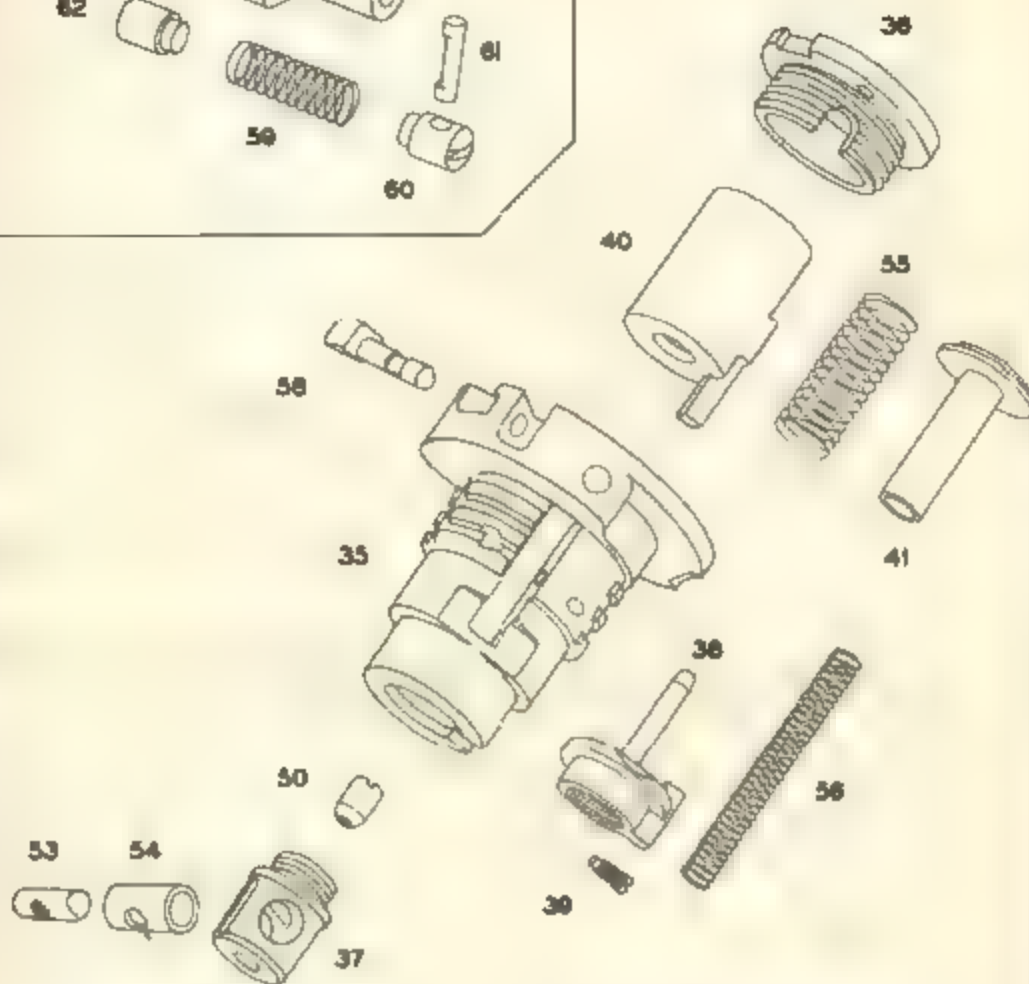




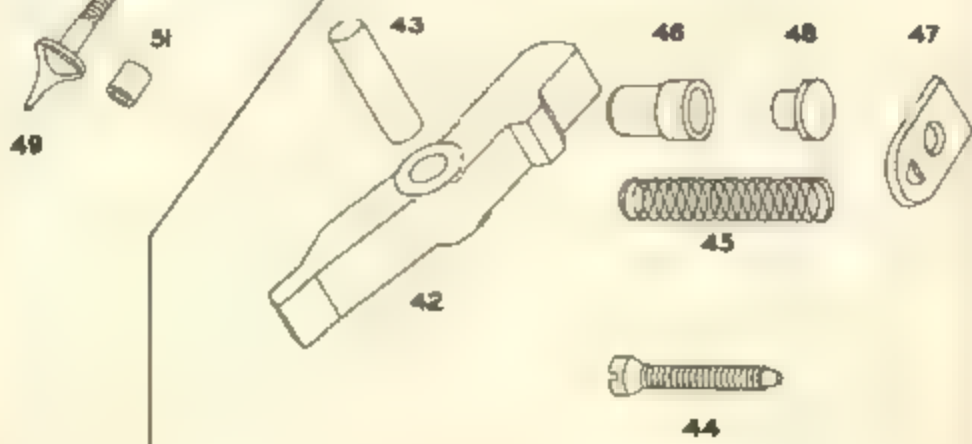
# CATCH, LEVER.

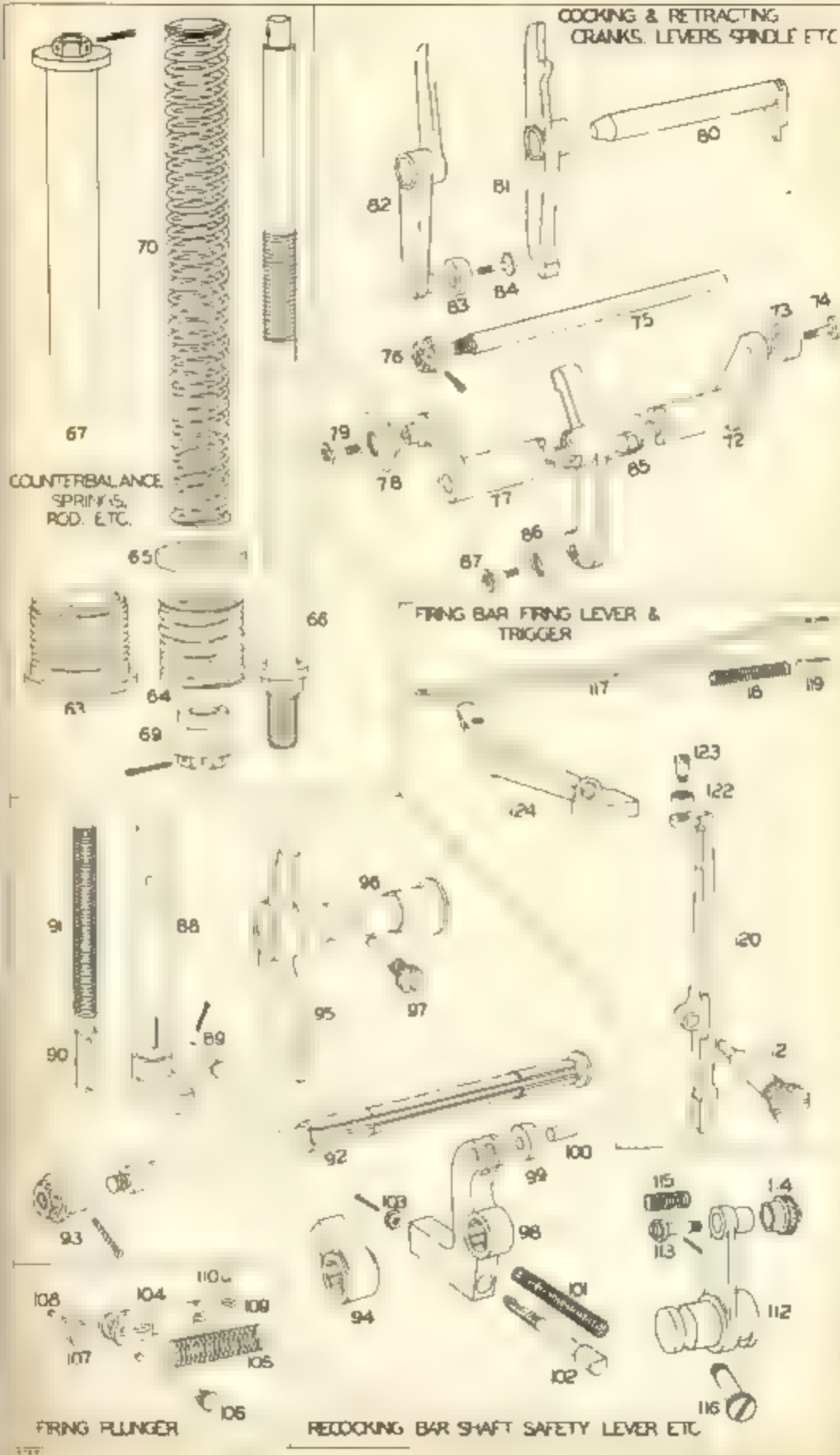


# FIRING CASE.



# TRIGGER SEAR & PLINGER





COCKING & RETRACTING  
CRANKS, LEVERS SPINDLE ETC

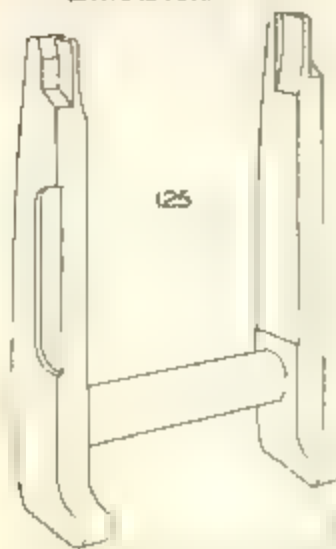
COUNTERBALANCE  
SPRING &  
ROD ETC.

FIRING BAR FIRING LEVER &  
TRIGGER

FIRING PLUNGER

RECOILING BAR SHAFT SAFETY LEVER ETC

EXTRACTOR.



125

ACTUATING SHAFT, CRANK, LEVER, Etc  
SLIDING BLOCK.



135

140



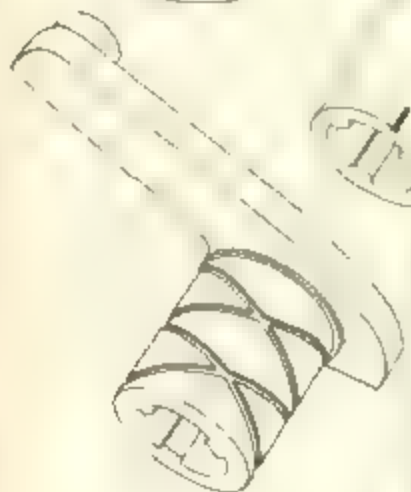
139



136



127



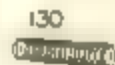
126



137

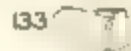


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130

34



133



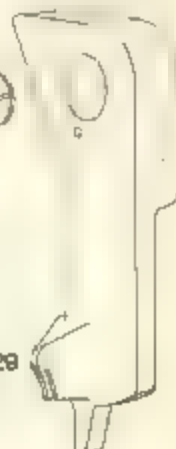
128



132



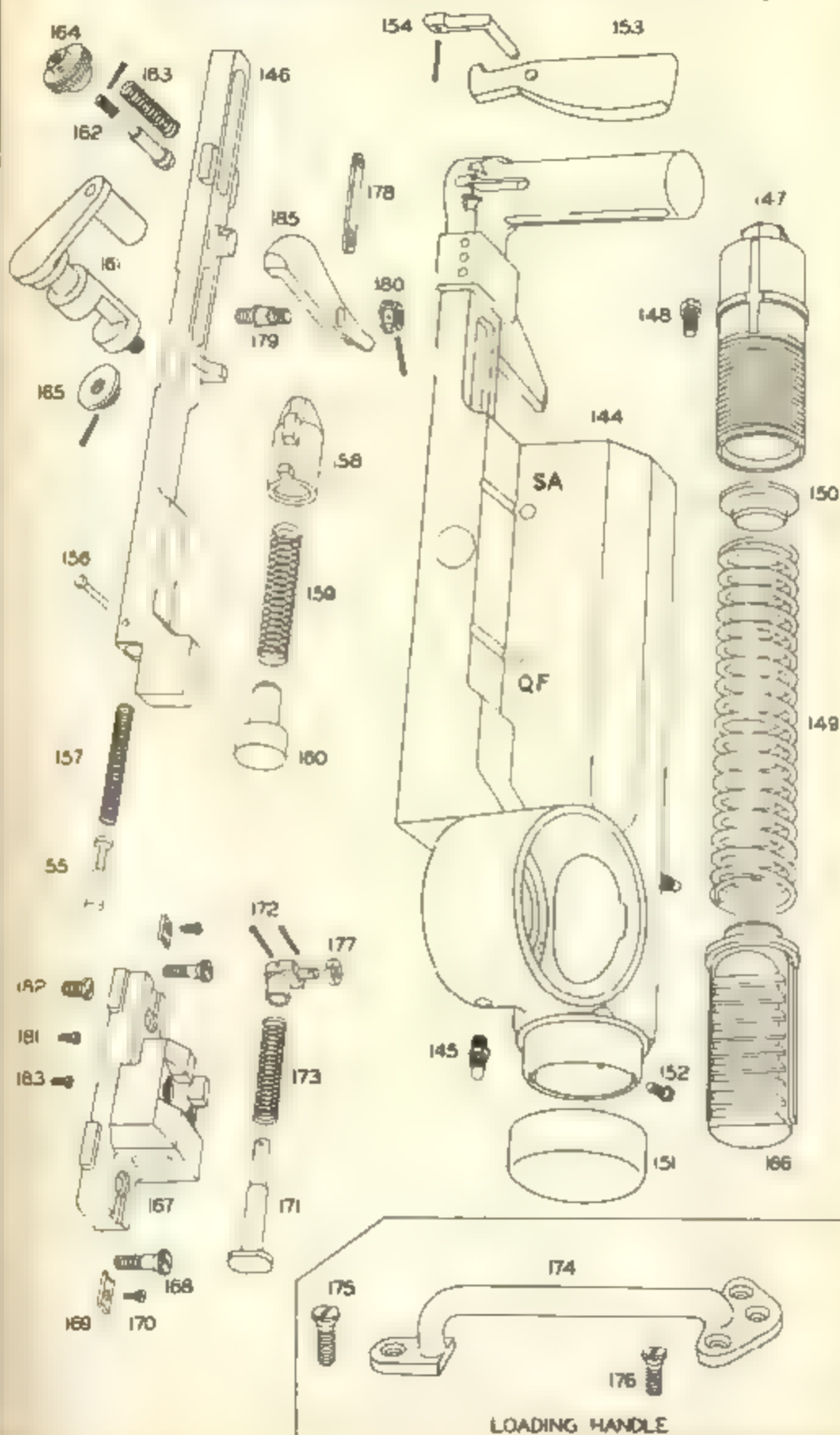
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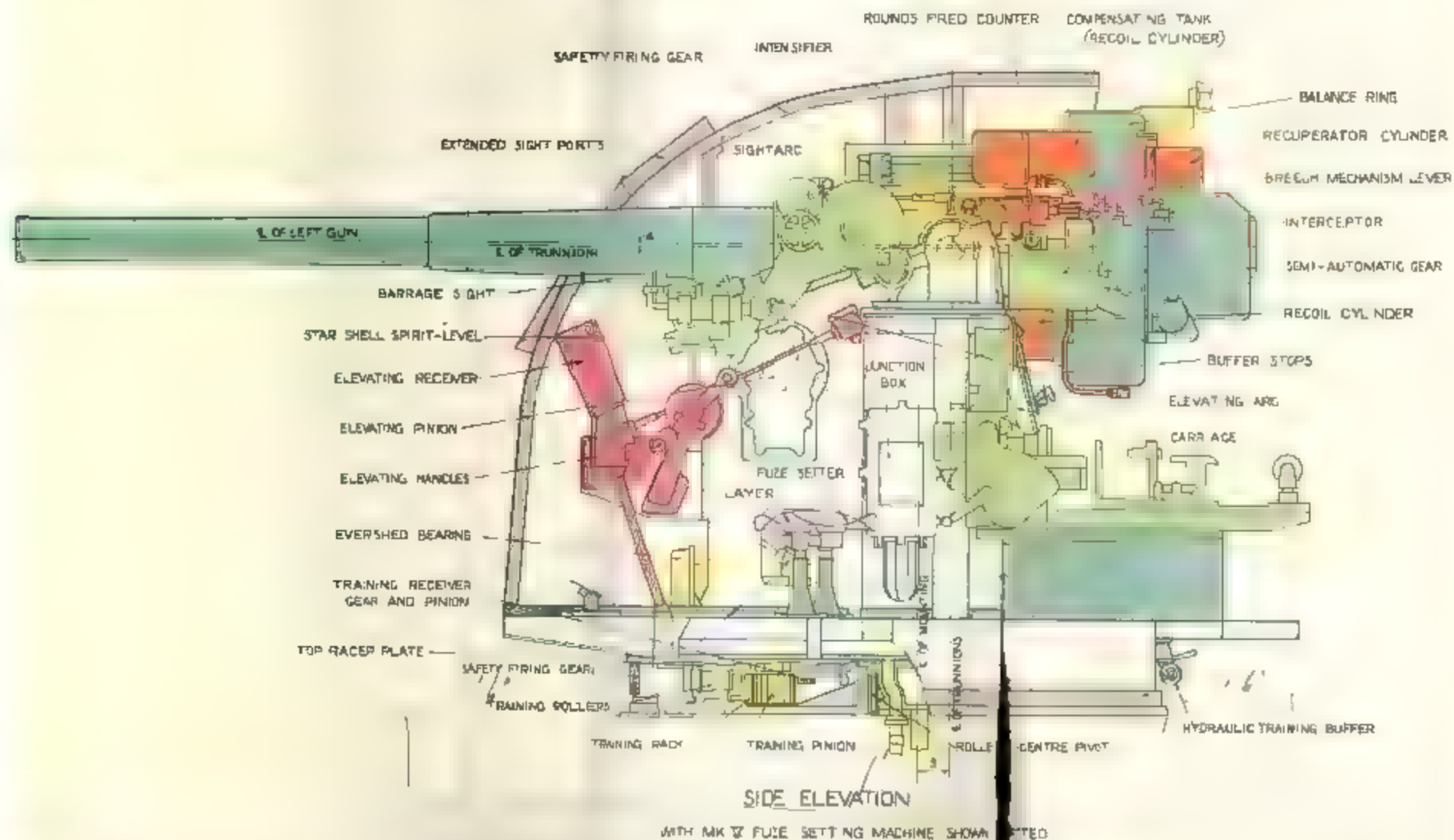
129

CATCHES RETAINING BREACH BLOCK OPEN.

# SM LEVER, CATCH BAR, ETC. (PARTS LIST) AND BRACKET STOP



# ARRANGEMENT OF MOUNTING MARK XIX.

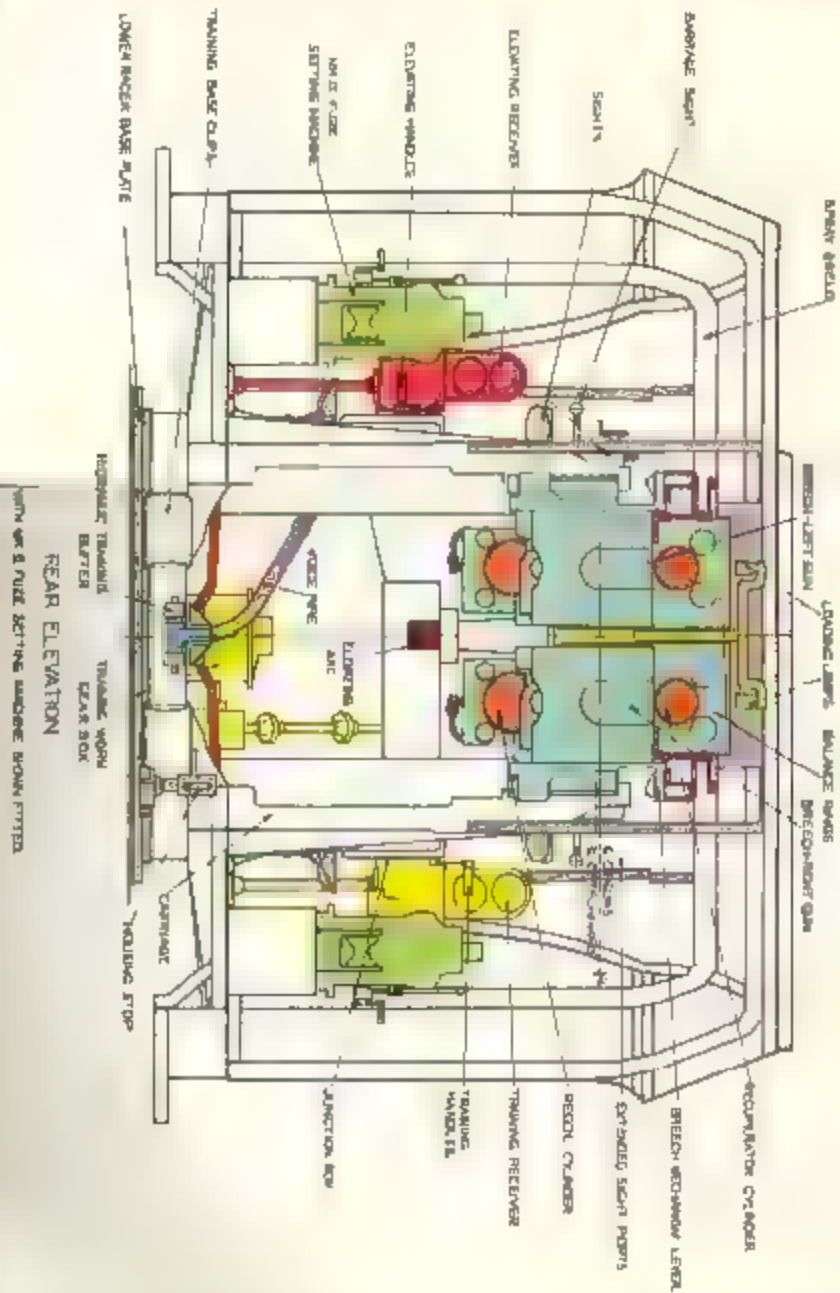


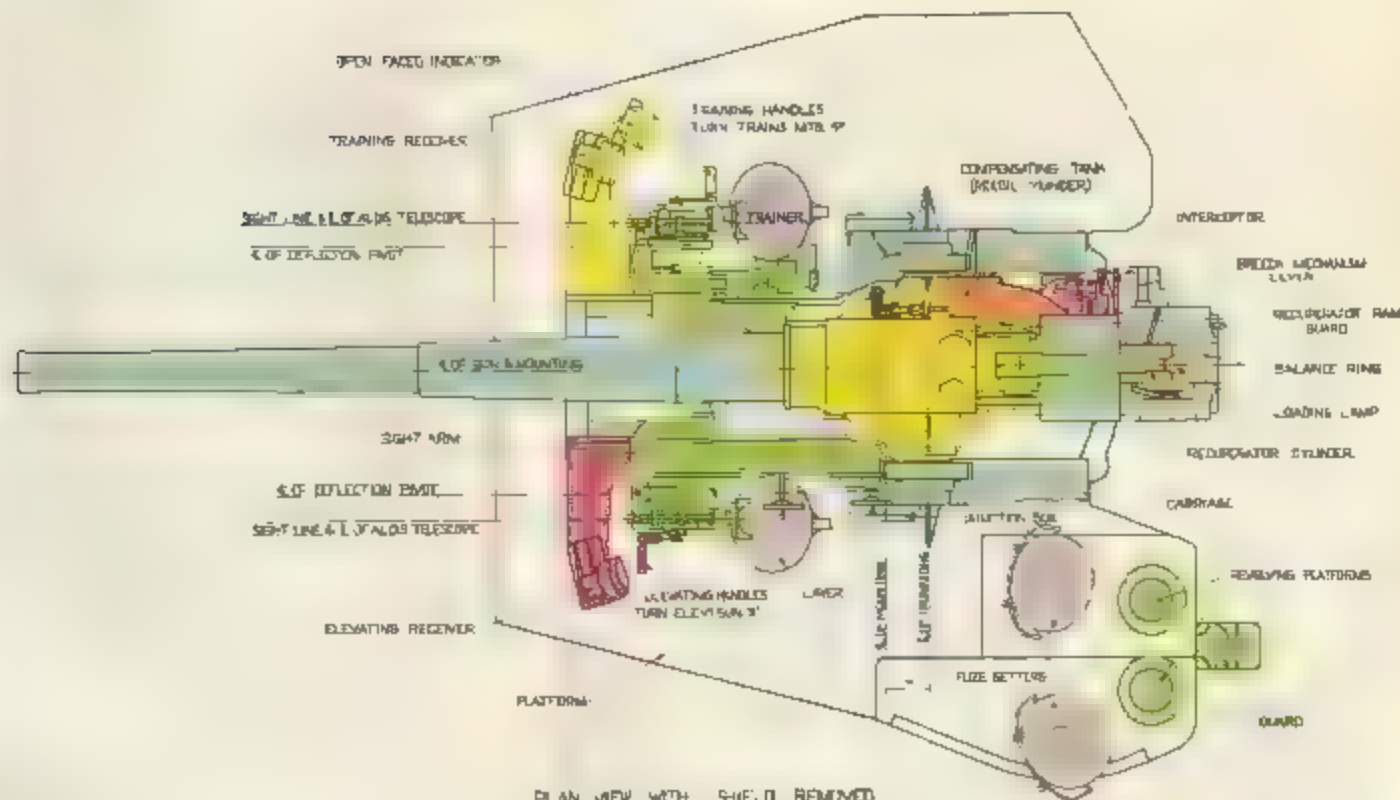




# ARRANGEMENT OF MOUNTING MARK XIX.

PLATE 3

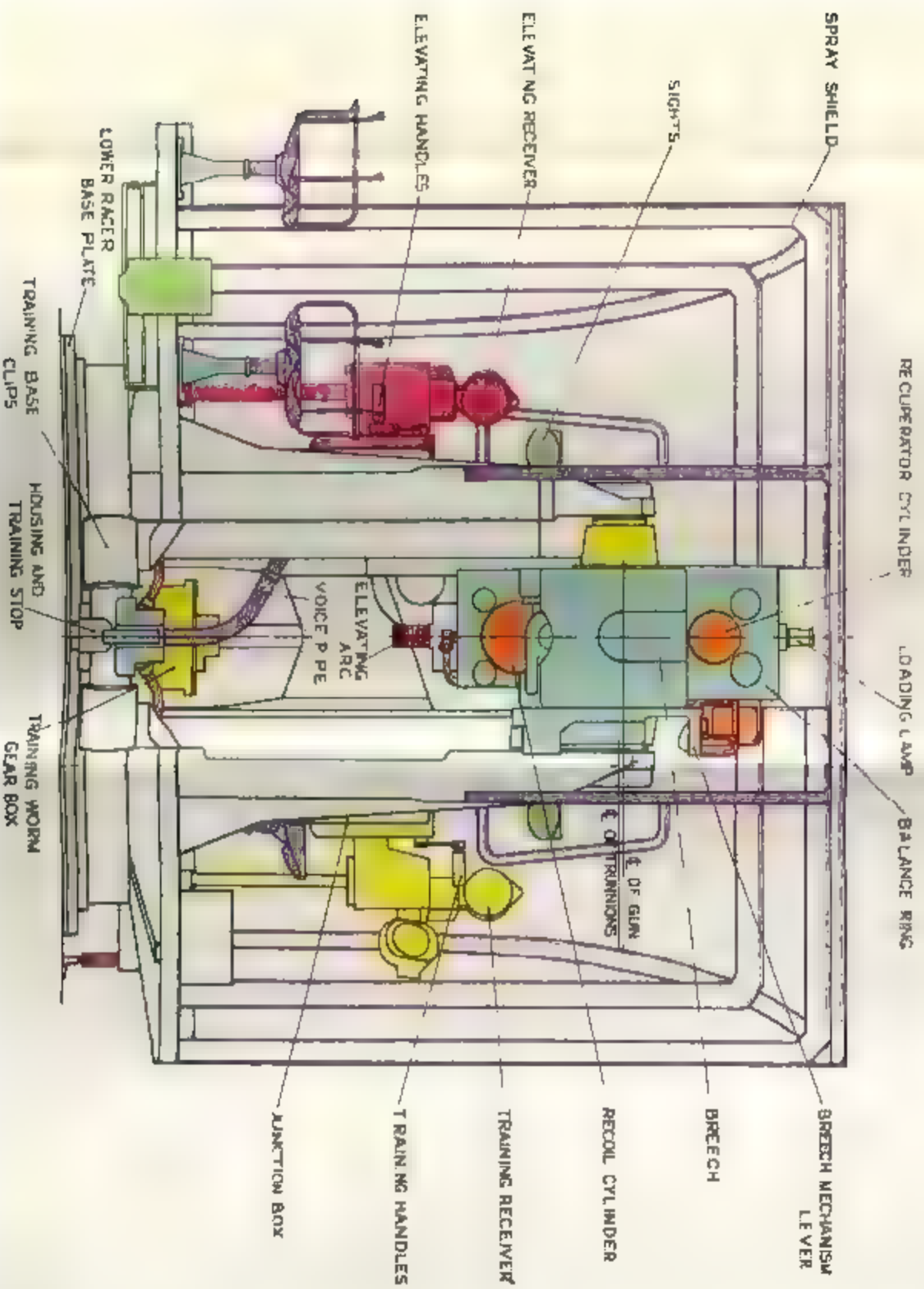


ARRANGEMENT OF MOUNTING MARK XX

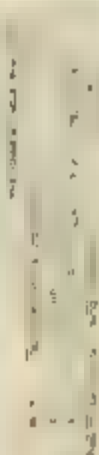
PLAN VIEW WITH SHIELD REMOVED  
WITH HAND FUZE SETTING ARRANGEMENT SHOWN FITTED

# ARRANGEMENT OF MOUNTING, MARK XX.

PLATE 5



THE 4 INCH MARK IS GUN



PAR: SECURITY WITH FREEDOM OF DATA

שם	מס' תע"ד	מס' תע"פ	מס' תע"מ	מס' תע"נ	מס' תע"ס	מס' תע"ת	מס' תע"י	מס' תע"ז	מס' תע"ח	מס' תע"ט	מס' תע"ק	מס' תע"ר	מס' תע"ש	מס' תע"פ	מס' תע"מ	מס' תע"נ	מס' תע"ס	מס' תע"ת	מס' תע"י	מס' תע"ז	מס' תע"ח	מס' תע"ט	מס' תע"ק	מס' תע"ר	מס' תע"ש
אברהם	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011	1012	1013	1014	1015	1016	1017	1018	1019	1020	1021	1022	1023	1024

[illegible]



# BREECH MECHANOPEN AND CLOSED.

Fig. 1. Breech open to the right.

Fig. 2. Breech open to the left.

Fig. 3. Breech closed.

Fig. 4. Breech closed.



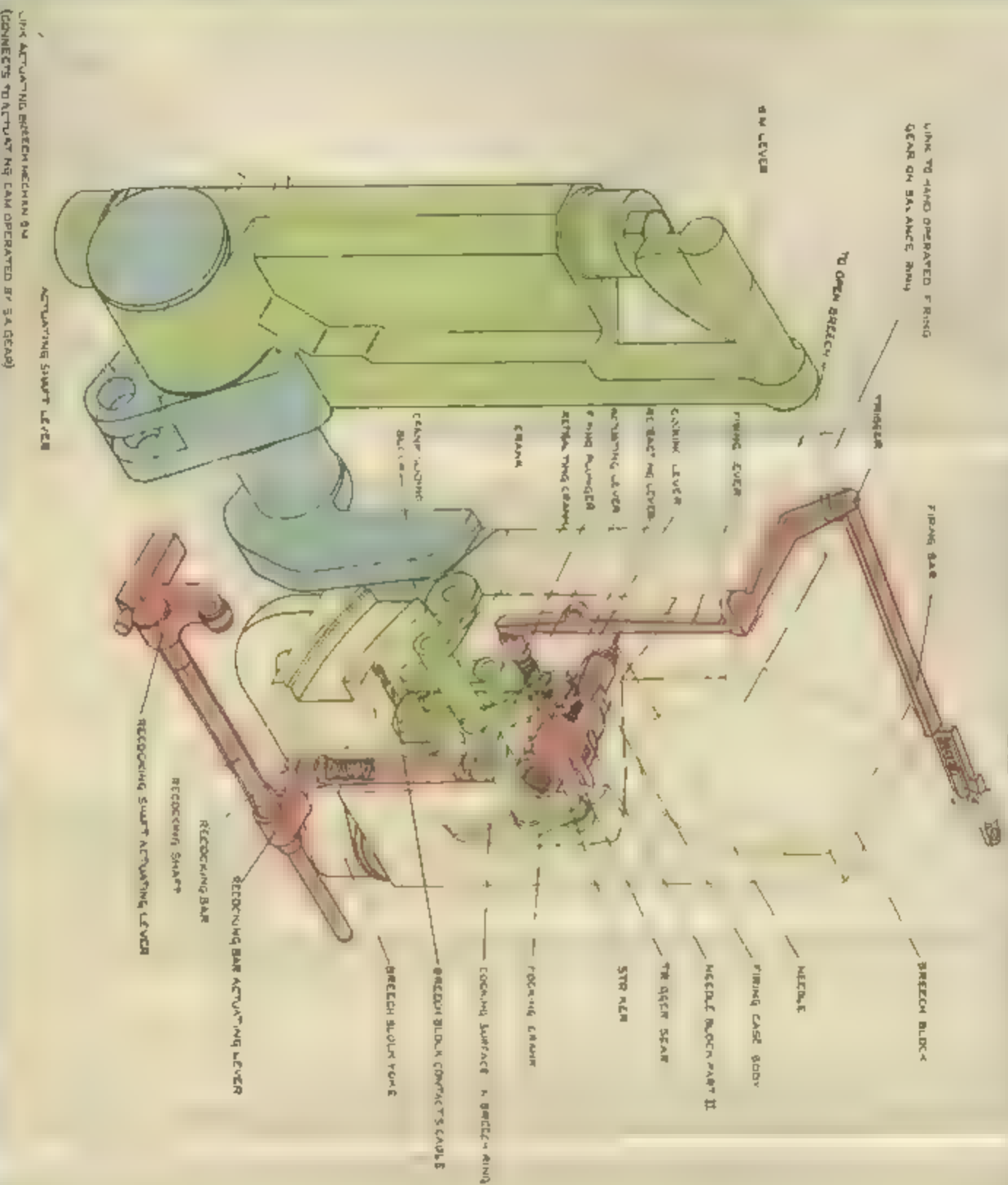
Fig. 1. Breech open to the right.

Fig. 2. Breech open to the left.

Fig. 3. Breech closed.

Fig. 4. Breech closed.

## ARRANGEMENT LEFT GUN.





# FIRING MECHANISM SIDE AND REAR ELEVATIONS

LEFT GUN SHOWN TYPICAL FOR RIGHT GUN

FIG. 2

1

2

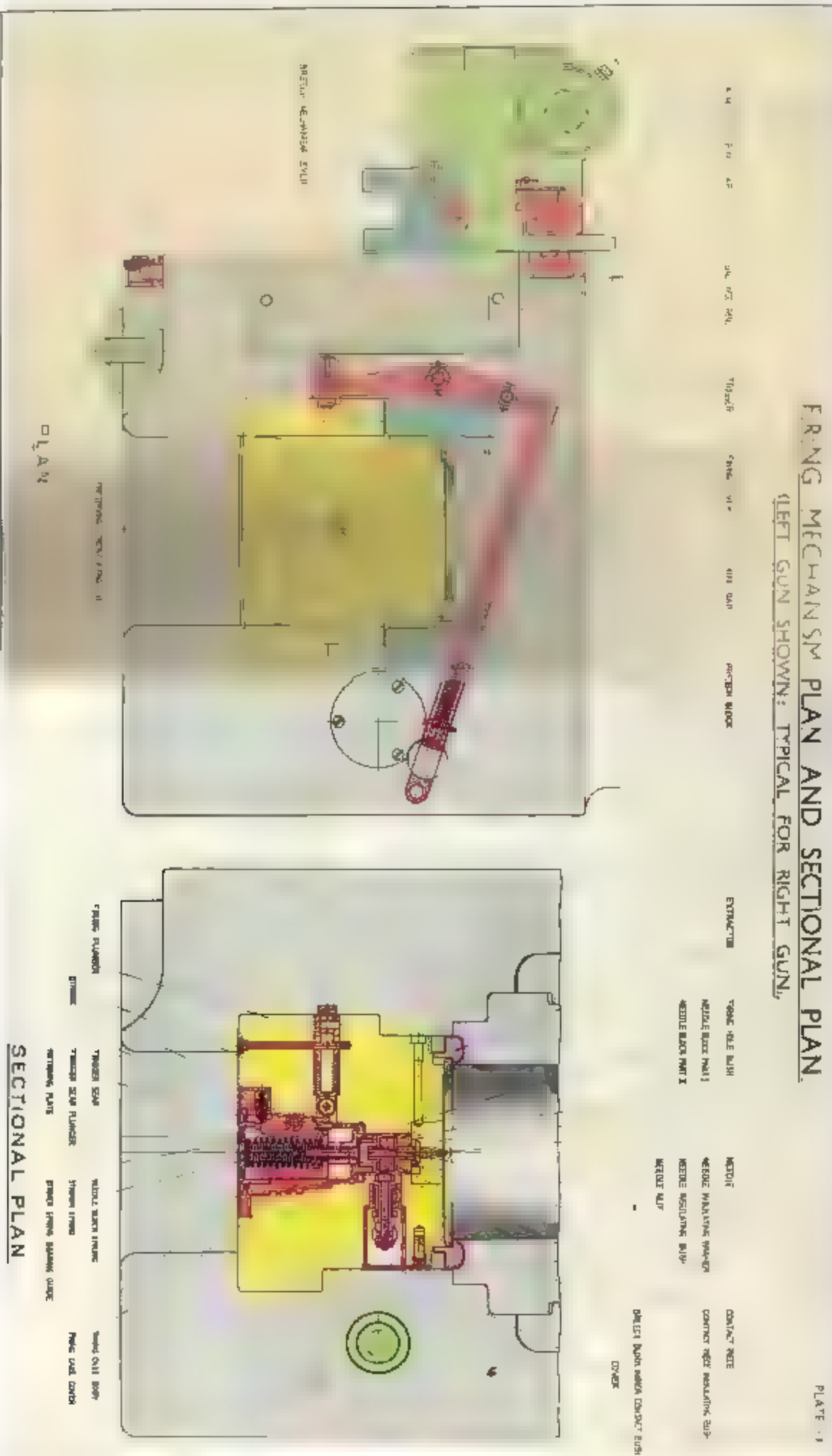
3

4

5



# FRING MECHANISM PLAN AND SECTIONAL PLAN. (LEFT GUN SHOWN; TYPICAL FOR RIGHT GUN.)



1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 841. 842. 843. 844. 845. 846. 847. 848. 849. 850. 851. 852. 853. 854. 855. 856. 857. 858. 859. 860. 861. 862. 863. 864. 865. 866. 867. 868. 869. 870. 871. 872. 873. 874. 875. 876. 877. 878. 879. 880. 881. 882. 883. 884. 885. 886. 887. 888. 889. 890. 891. 892. 893. 894. 895. 896. 897. 898. 899. 900. 901. 902. 903. 904. 905. 906. 907. 908. 909. 910. 911. 912. 913. 914. 915. 916. 917. 918. 919. 920. 921. 922. 923. 924. 925. 926. 927. 928. 929. 930. 931. 932. 933. 934. 935. 936. 937. 938. 939. 940. 941. 942. 943. 944. 945. 946. 947. 948. 949. 950. 951. 952. 953. 954. 955. 956. 957. 958. 959. 960. 961. 962. 963. 964. 965. 966. 967. 968. 969. 970. 971. 972. 973. 974. 975. 976. 977. 978. 979. 980. 981. 982. 983. 984. 985. 986. 987. 988. 989. 990. 991. 992. 993. 994. 995. 996. 997. 998. 999. 1000.

SECTIONAL PLAN



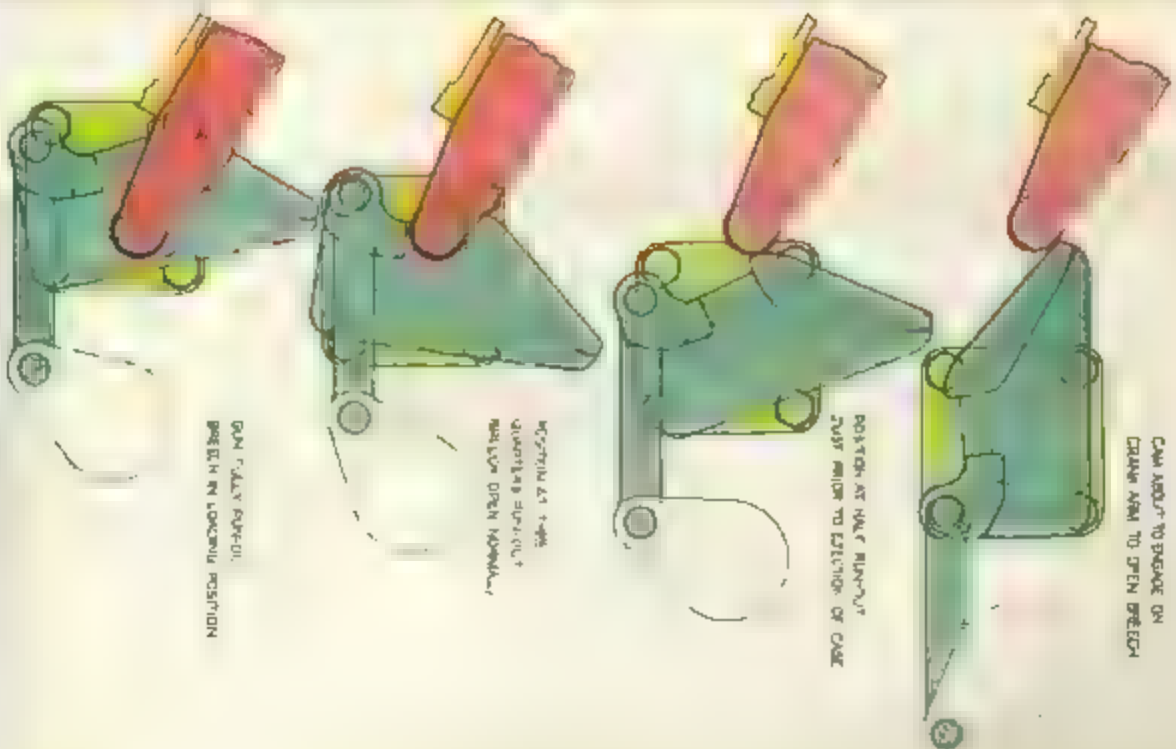


# DIAGRAMS OF SEMI-AUTOMATIC GEAR OPERATION

ACTION DURING RECOIL

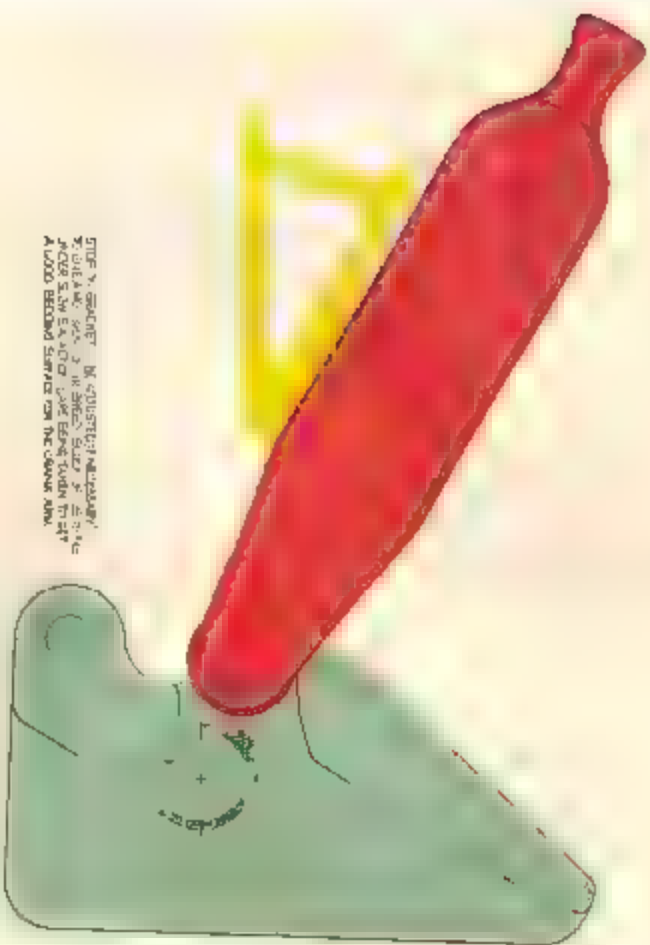


ACTION DURING RUN-OUT

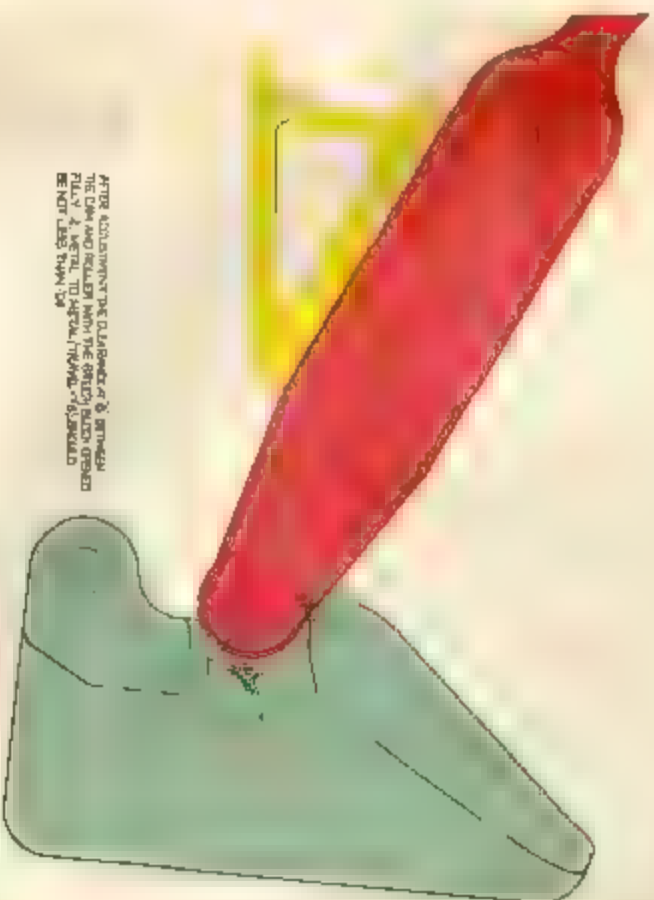


# ADJUSTMENT OF S-A GEAR.

PLATE 14



STEP 1. GRABBY IN COLLECTED MATERIAL  
TO BE ADJUSTED IN THE GEAR. IT IS THE  
FINGER S.A. AND THE GEAR BEING TIGHTEN TO GET  
A GOOD BEARING SURFACE FOR THE GEAR AND

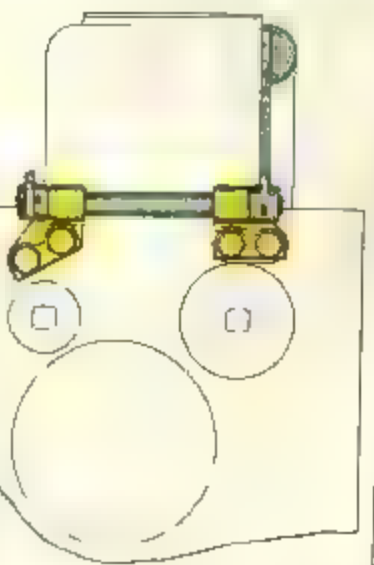


AFTER ADJUSTING THE DIAMETER OF THE GEAR  
THE GEAR AND RELAXED WITH THE GEAR BEING  
TIGHTENED TO GET A GOOD BEARING SURFACE  
BE NOT LESS THAN 10

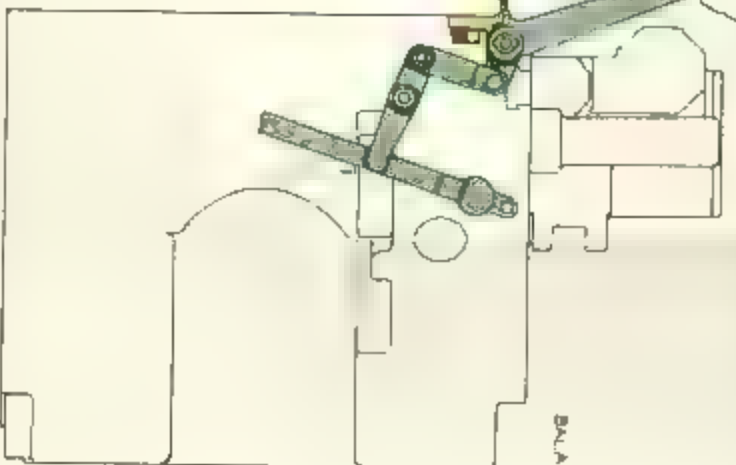
# HAND OPERATED PERCUSSION FIRING GEAR.

10

PLATE 5

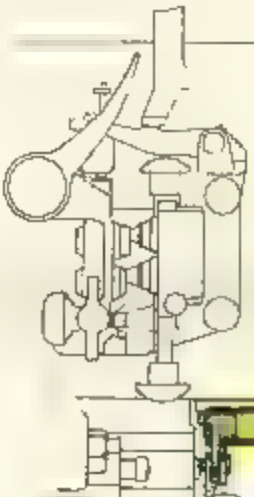


STOP ON PALM LEVER  
OF RIGHT HAND GUN ONLY



PLAN /IEW  
ARRANGEMENT OF LEVERS  
FOR RIGHT HAND GUN

BALANCE RING

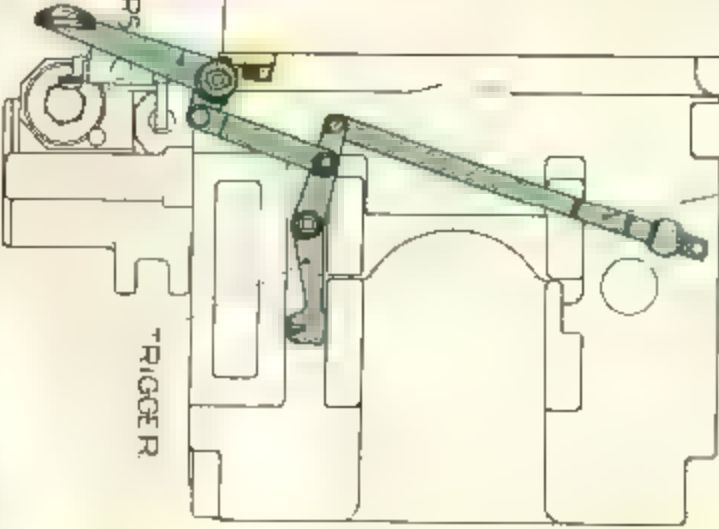


SPRING

FIRING BAR

PALM LEVER

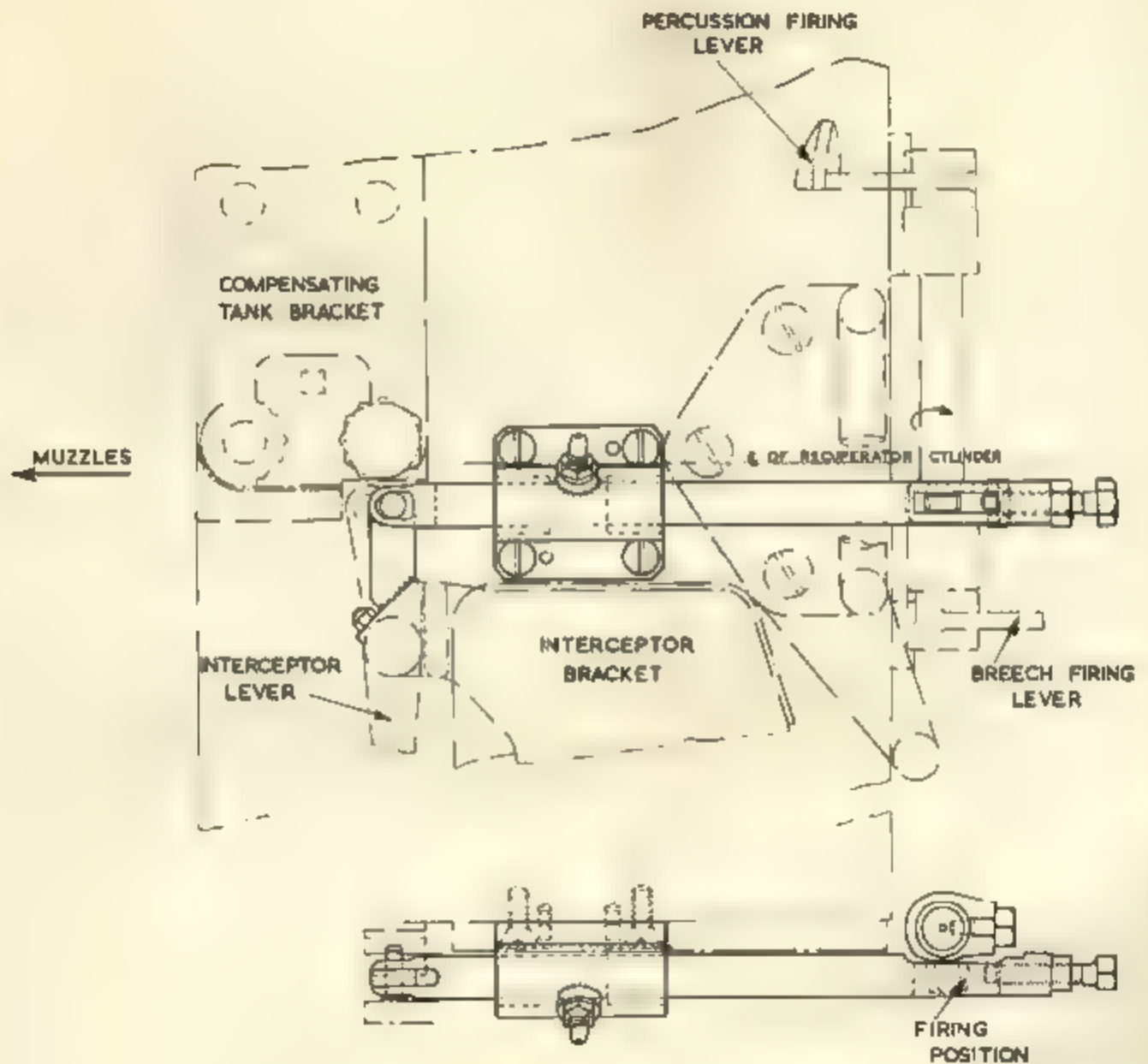
ARRANGEMENT OF LEVERS  
FOR LEFT HAND GUN



TRIGGER

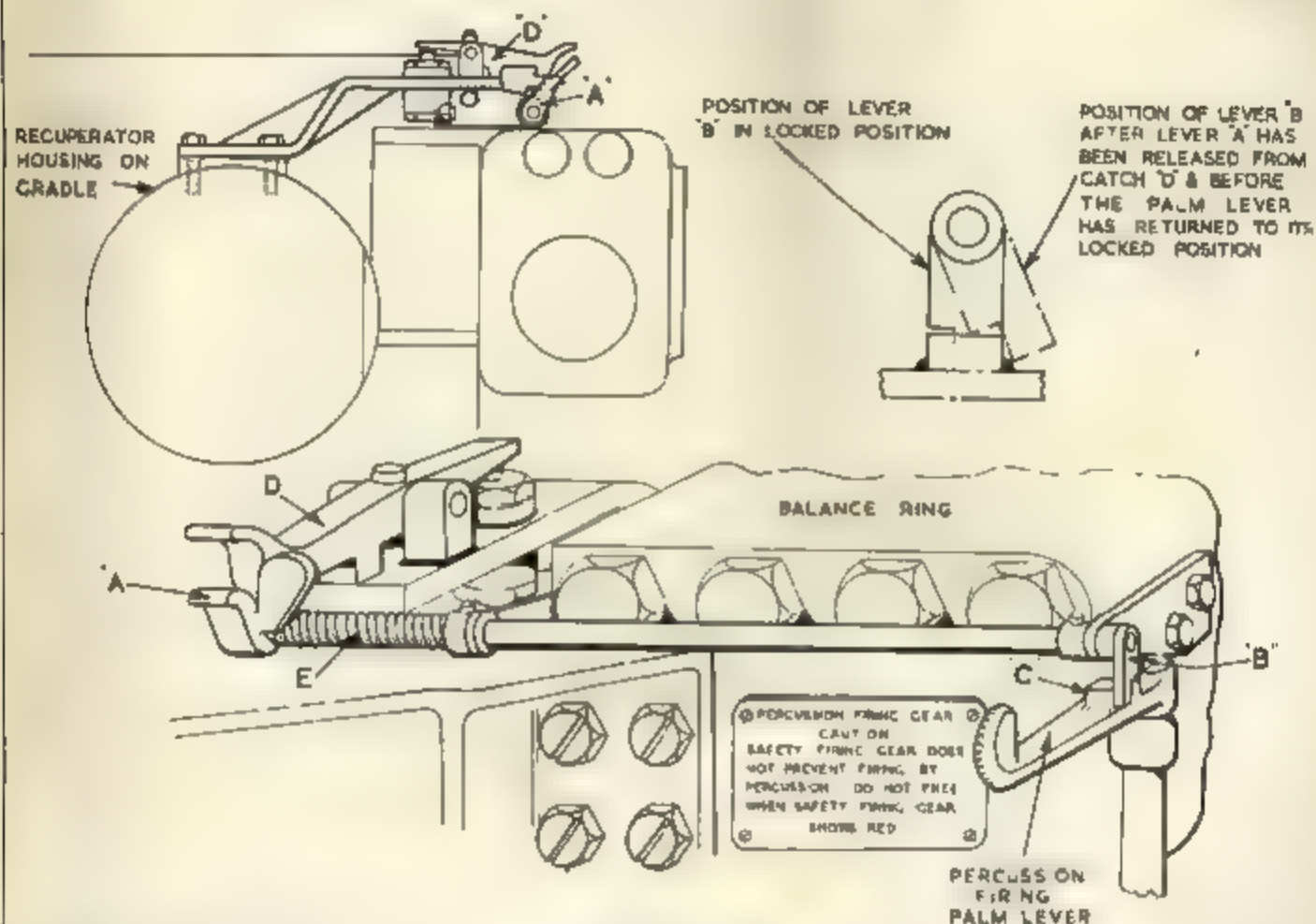
# 4 INCH H. A. TWIN MOUNTING MARK XIX

## ARRGT. OF SAFETY PERCUSSION FIRING GEAR.





# 4 IN. H.A. TWIN MK. XIX PERCUSSION FIRING GEAR INTERLOCK-FOR MOUNTINGS FITTED WITH SAFETY FIRING SWITCH GEAR



## DESCRIPTION

LOCKING LEVER 'B' COMBINES WITH STOP 'C' TO PREVENT MOVEMENT OF THE PALM LEVER. BEFORE THE PALM LEVER CAN BE OPERATED FOR PERCUSSION FIRING, LEVER 'B' MUST BE RAISED CLEAR OF STOP 'C'. THIS IS DONE BY RAISING LEVER 'A' INTO A VERTICAL POSITION AND CLIPPING IT UNDER CLIP 'D'. LEVERS 'A' AND 'B' ARE BOTH MOUNTED ON THE BALANCE RING AND RECOIL WITH THE GUN. CLIP 'D' IS SECURED TO THE CRADLE AND REMAINS STATIONARY. AS SOON AS THE GUN BEGINS TO RECOIL, LEVER 'A' (WHICH IS SPRING LOADED) IS DRAWN BACKWARDS CLEAR OF THE CLIP 'D' AND DROPS DOWN.

LEVER 'B' ALSO DROPS AND COMES TO REST ON TOP OF THE STOP 'C' WHERE IT REMAINS DURING THE REMAINDER OF THE RECOIL.

WHEN THE BREECH MECHANISM RETURNS THE PALM LEVER TO ITS ORIGINAL POSITION, LOCKING LEVER 'B' DROPS BEHIND THE STOP 'C' AND PREVENTS THE GUN BEING AGAIN FIRED BY PERCUSSION UNTIL LEVER 'A' IS RAISED AS ABOVE. WHEN THE GUN IS BEING FIRED ELECTRICALLY, BOTH LEVERS 'A' AND 'B' ARE KEPT IN THE DOWNWARD POSITION BY MEANS OF SPRING 'E'.

$$T, j, \theta, \mu, \lambda, \Gamma, \gamma, \kappa, \tau, \eta, \lambda, \varepsilon$$

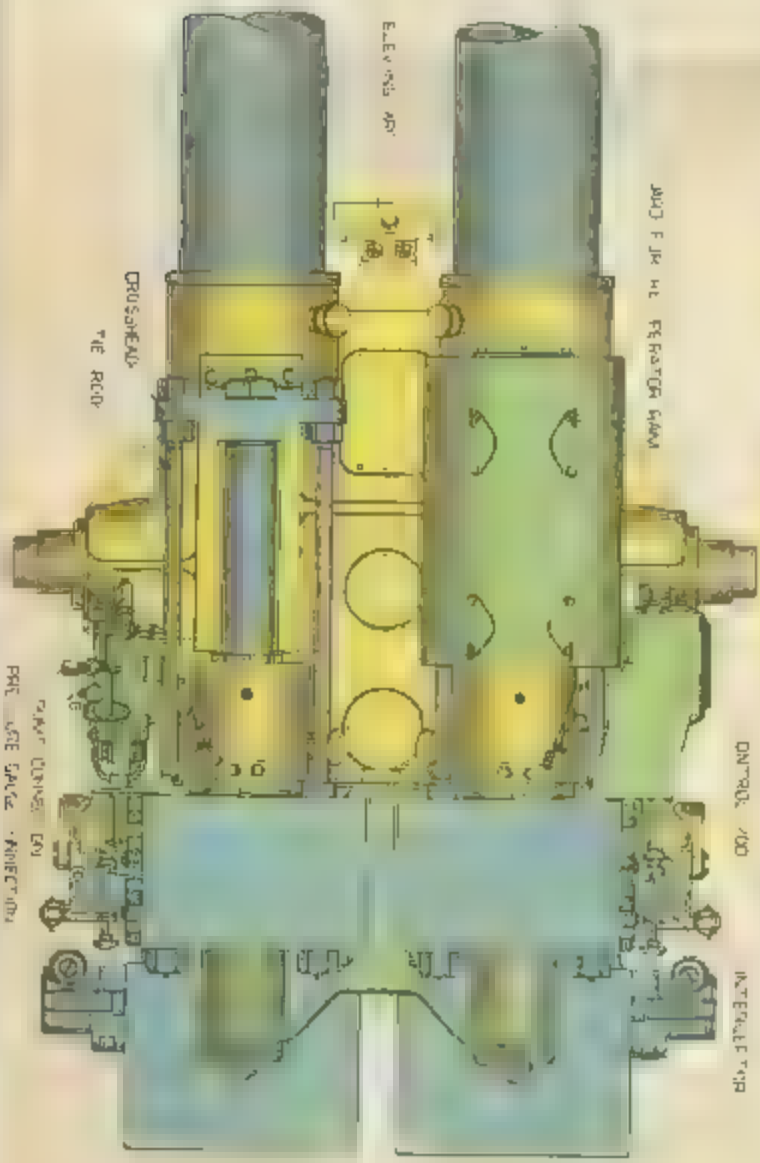
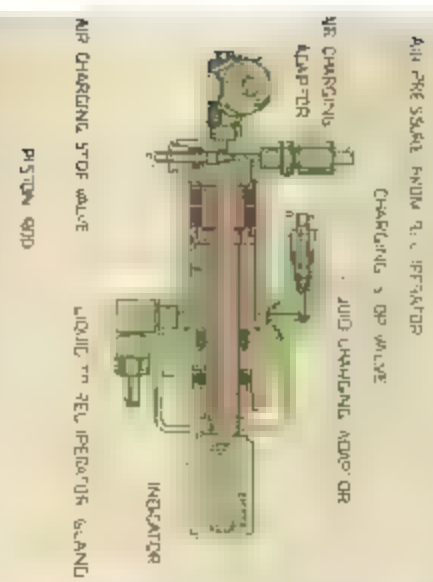
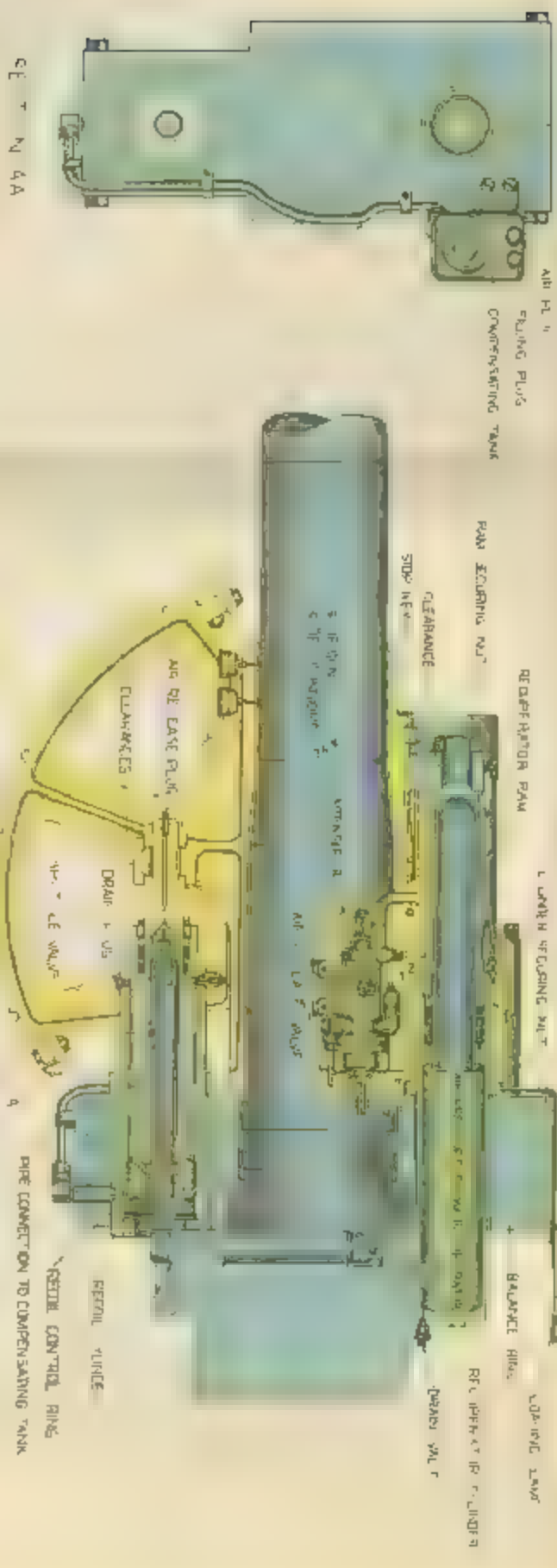

Fig. 3.



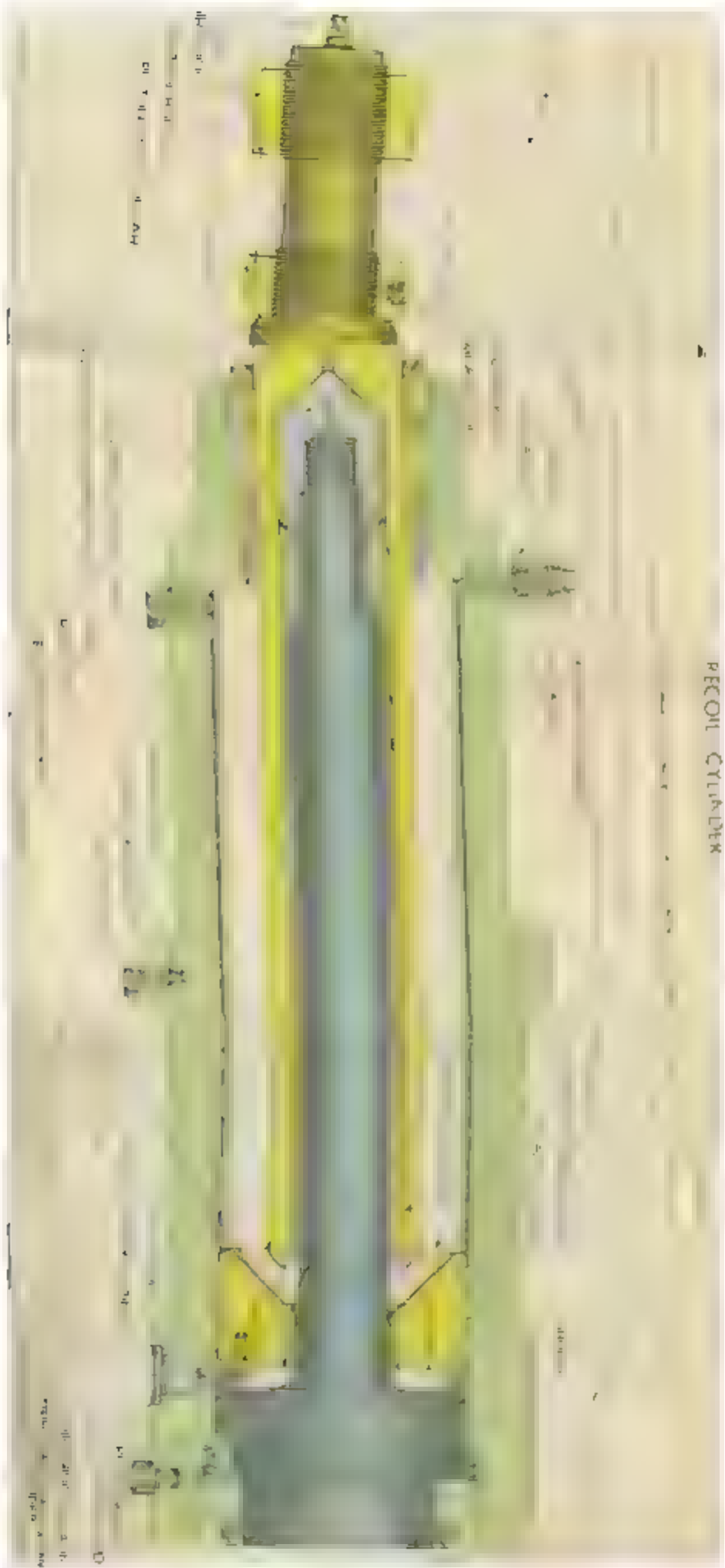
July 23



# CRADLE, RECOIL AND RUN-OUT ARRANGEMENTS,

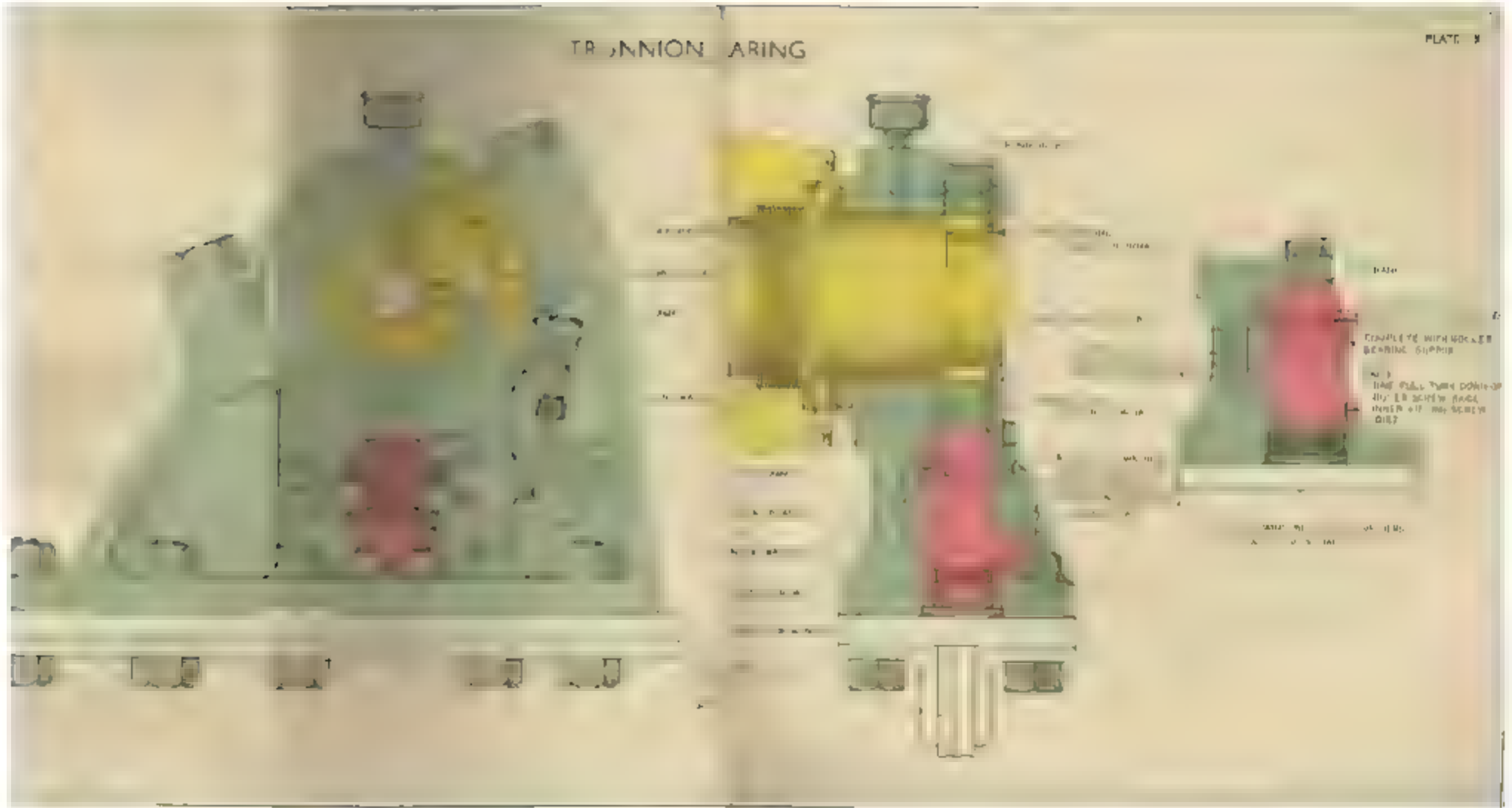


РЕКОМЕНДАЦИИ



# TR UNION ARING

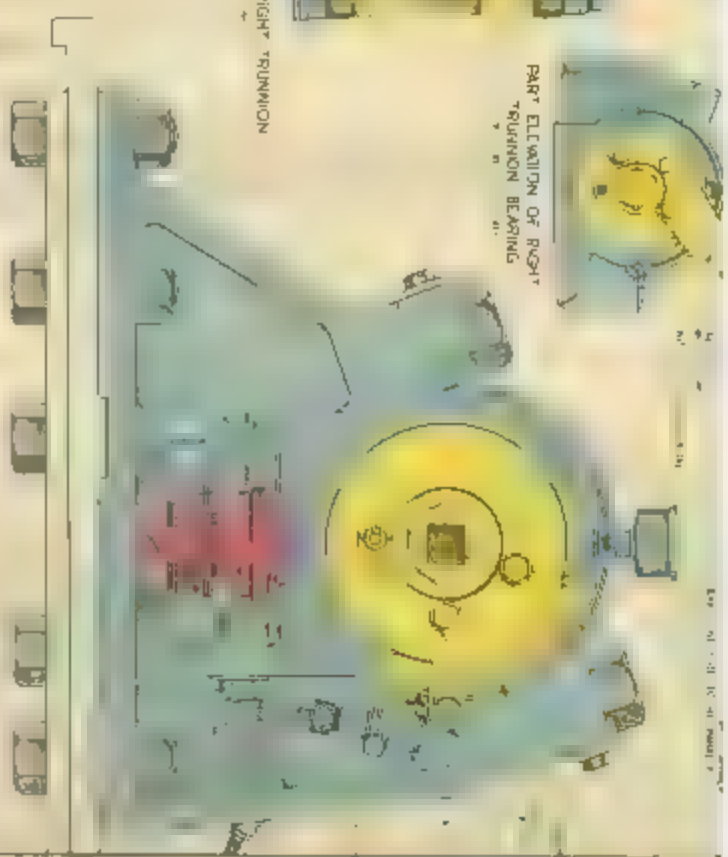
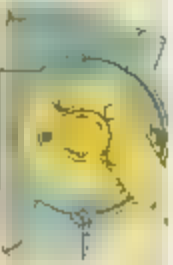
PLATE 9



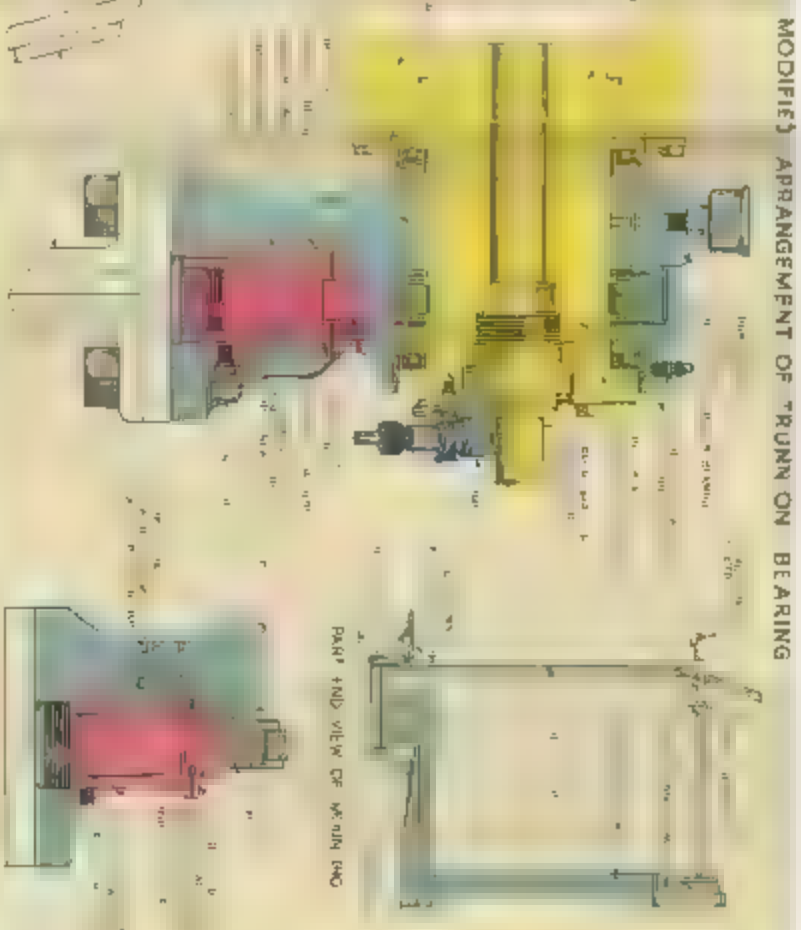




PART ELEVATION OF RIGHT TRUNNION BEARING



ELEVATION OF LEFT TRUNNION BEARING



MODIFIED ARRANGEMENT OF TRUNNION BEARING

PART AND VIEW OF WHEEL END

SECTION AT C OF LEFT TRUNNION

SECTION SHOWING BELLEVILLE WASHERS READY FOR DISASSEMBLING

NUZZLE CAP SLIP HOOK VIEW FROM BELOW



REAR LINKS

LINE SECURED TO SHIPS  
STRUCTURE TO PREVENT GEAR  
FALLING WHEN SLIP HOOK IS  
RELEASED

TEMPORARY SUPPORT ATTACH TO TAKE  
WEIGHT OF GEAR UNTIL LINKS ARE ASSEMBLED

\* TO SUPPORT AND  
SLIP HOOK IS RELEASED

## HAULING BACK GEAR

RAT ME

R - 36 IN

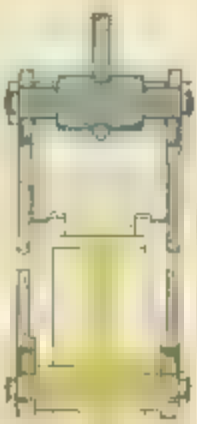
LH 50 IN

SHARP LOOSE SHAWT

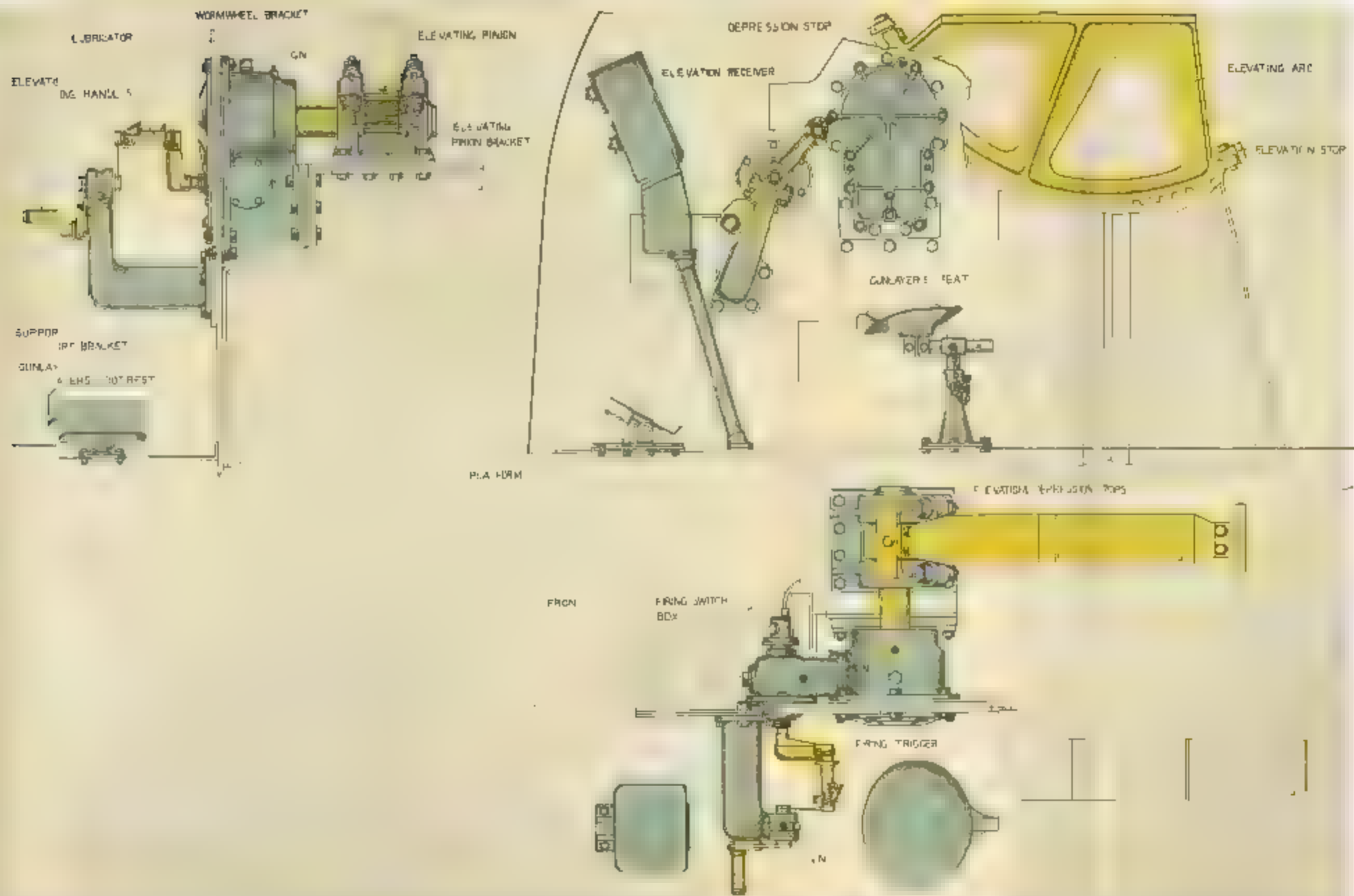
4' HA MARK XIX MOUNTINGS  
ASSEMBLY OF REAR LINKS

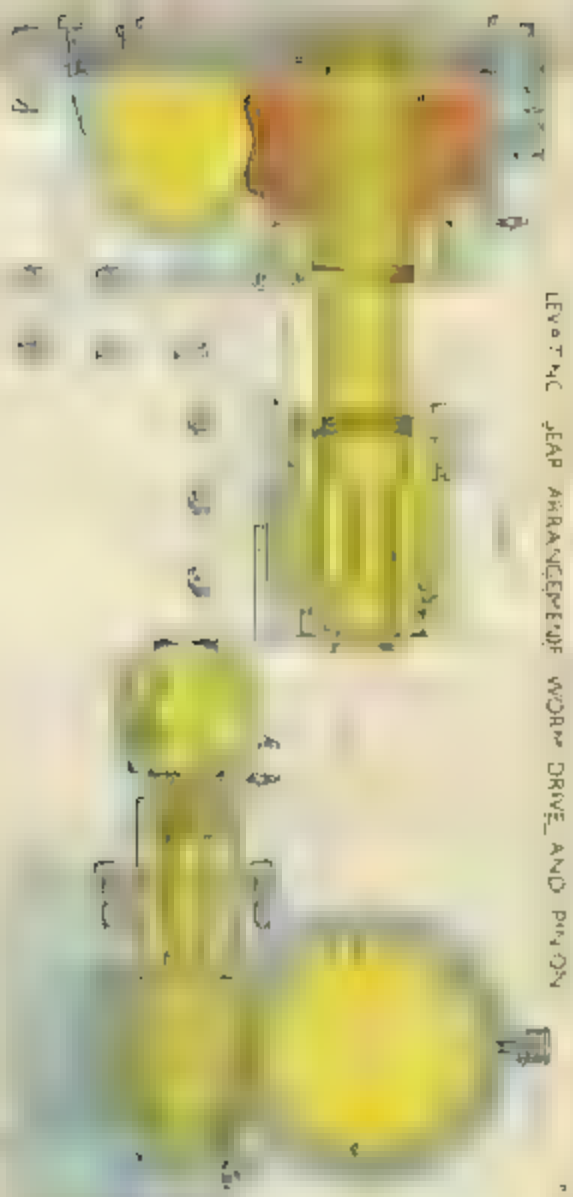


4' HA MARK XX MOUNTINGS  
ASSEMBLY OF REAR LINKS

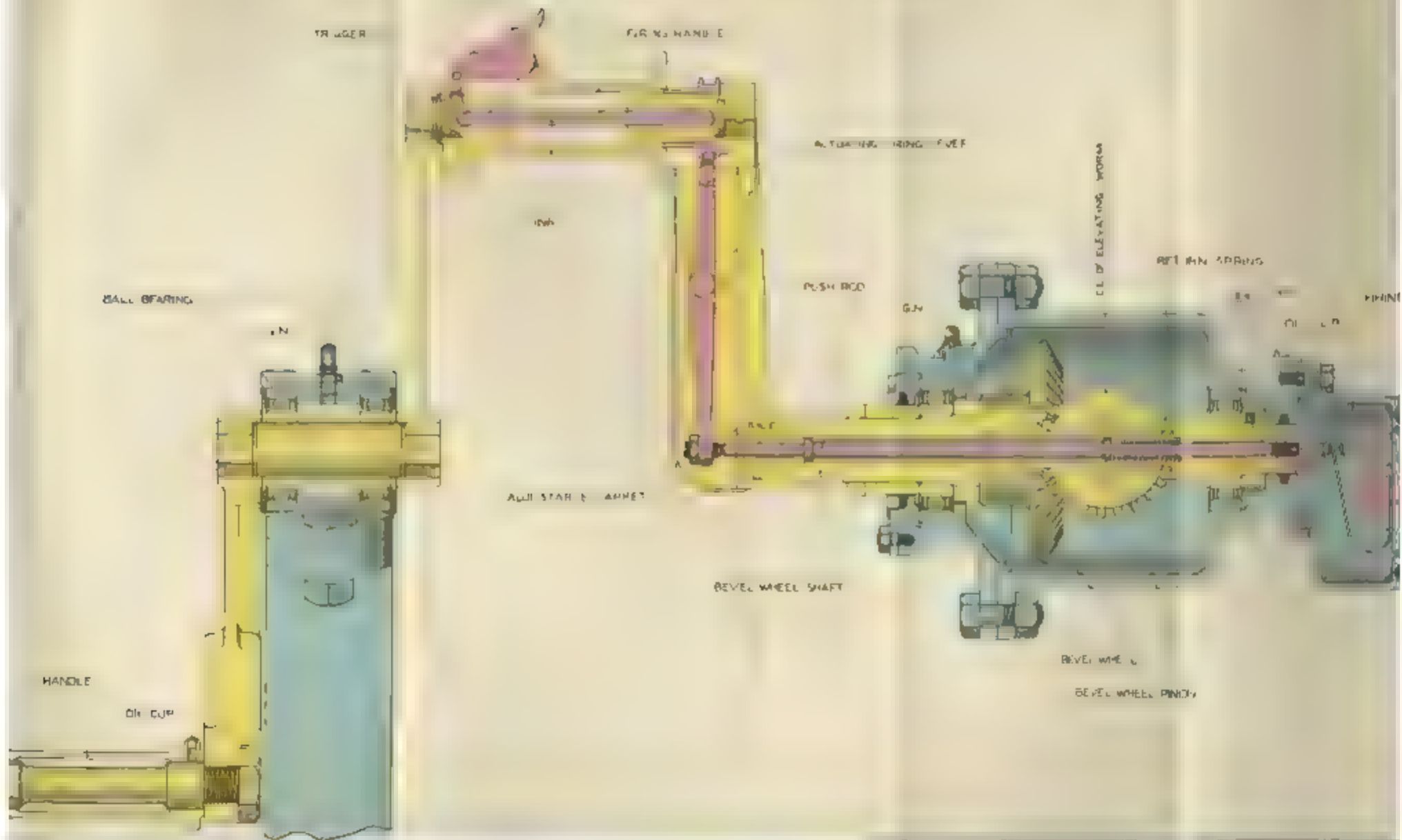


# ELEVATING GEAR-GENERAL ARRANGEMENT





# GUNLAYER'S FIRING GEAR.

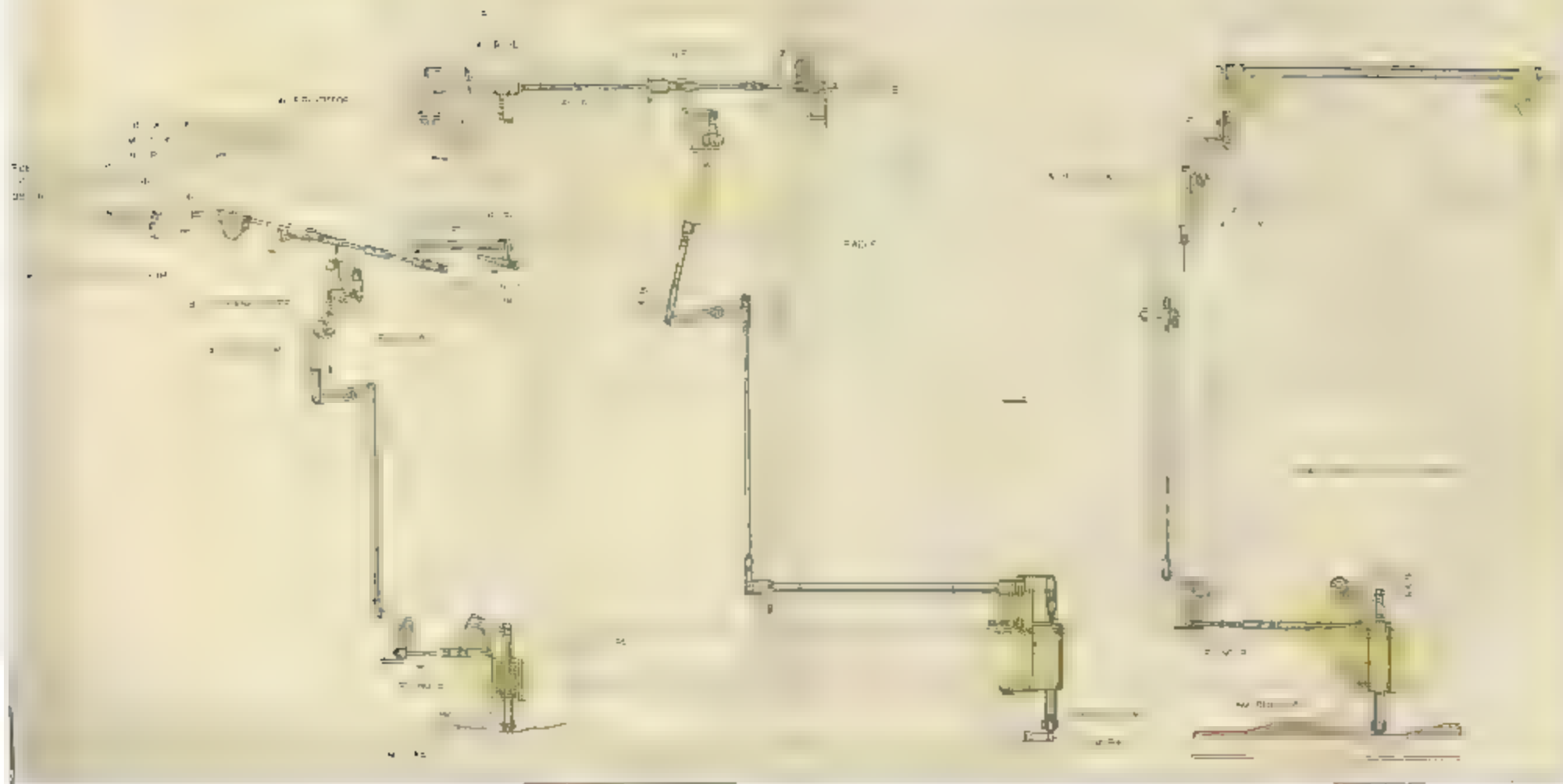




# SAFETY FRING GEAR MARK XIX MTG

DATE: 1/1/1919  
BY: J. H. B.

7 1 1



# SAFETY FIRING SWITCH AND OPERATING GEAR

EXPANDED VIEW OF  
INDICATOR QUADRANT

FIRING CIRCUIT  
BASKET

RIGHT TRUNNION PIN

INDICATOR

ADJUSTABLE  
DOUBLE EYE

INSPECTION DOOR

REFERENCE COLOUR  
OF INDICATOR  
WHEEL

SYMBOLS  
ENDS GREASE ONLY NIPPLES  
SPRINGER OIL CUPS

ON OPPOSITE  
TRUNNION PIN

CONTROL SEGMENTS

LEFT SCREW

APPROX.

PL. WHEEL

GUIDE RIB

CABLE

ANTI BACKLASH  
SPRING HOUSING

LOCKING SCREW

SECTION OF  
SAFETY FIRING SWITCH

SAFETY  
SPRING ARM

FLIGHT LEVER

SPRING LOADED  
PLUNGER

CAM ROLLER

SECTION OF  
GUIDE BRACKET AND  
SPRING LOADED PLUNGER

GUIDE BRACKET

CAM SHAFT

FIRST STOP

CAM ROLLER

ROLLER ARM

COVER

TRUNNION

BRAC NET

CROSSHEAD

WEATHER  
PROTECTIVE  
COVER

LOCKING  
BOLT

LOADING  
SLAVE

GUIDE BRAC NET

PINGS

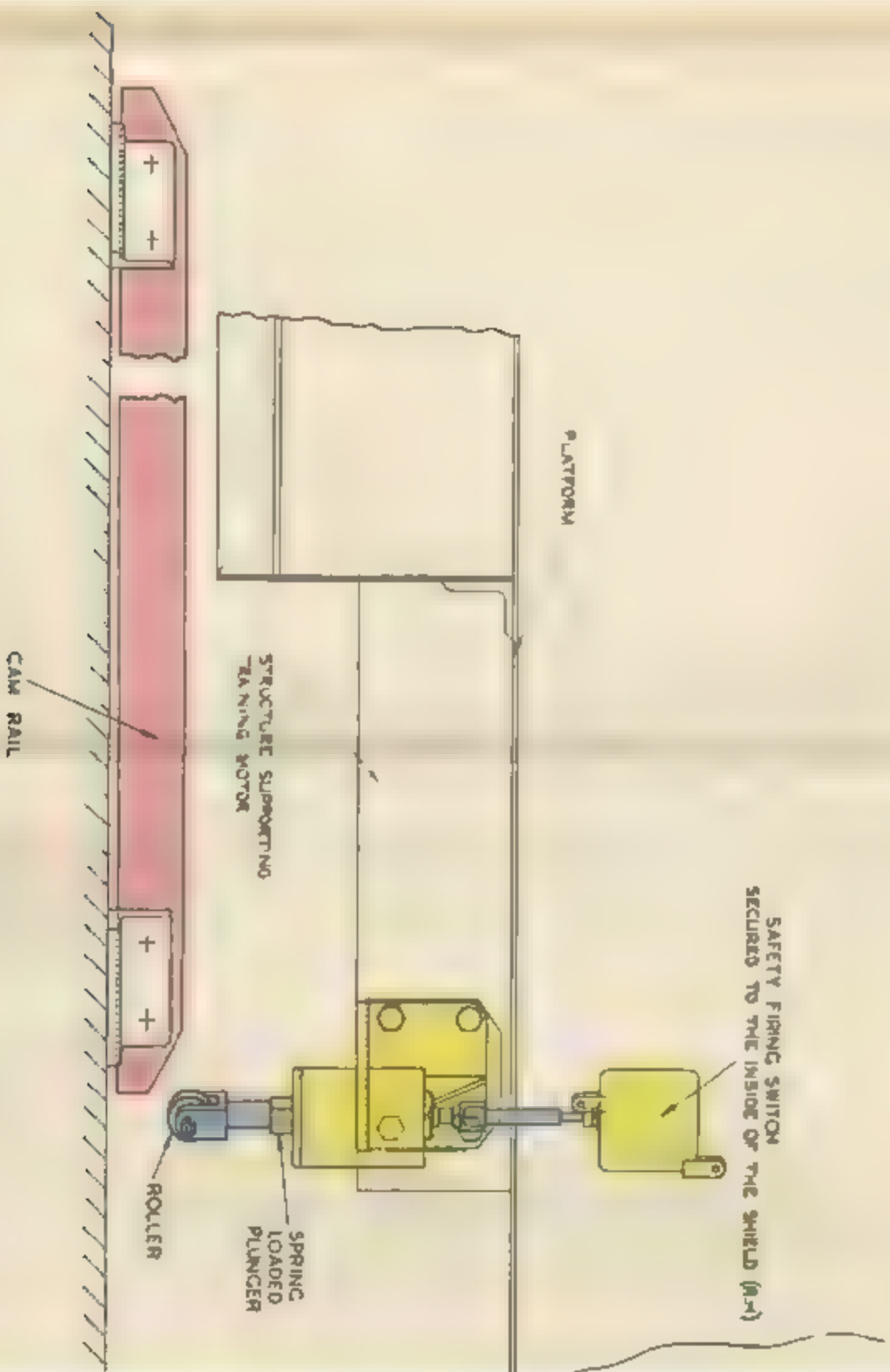
JOULEON

LINK

1/2 1/4 1/8 1/16 1/32 1/64 1/128 1/256 1/512 1/1024 1/2048 1/4096 1/8192 1/16384 1/32768 1/65536 1/131072 1/262144 1/524288 1/1048576 1/2097152 1/4194304 1/8388608 1/16777216 1/33554432 1/67108864 1/134217728 1/268435456 1/536870912 1/1073741824 1/2147483648 1/4294967296 1/8589934592 1/17179869184 1/34359738368 1/68719476736 1/137438953472 1/274877906944 1/549755813888 1/1099511627776 1/2199023255552 1/4398046511104 1/8796093022208 1/17592186044416 1/35184372088832 1/70368744177664 1/140737488355328 1/281474976710656 1/562949953421312 1/1125899906842624 1/2251799813685248 1/4503599627370496 1/9007199254740992 1/18014398509481984 1/36028797018963968 1/72057594037927936 1/144115188075855872 1/288230376151711744 1/576460752303423488 1/1152921504606846976 1/2305843009213693952 1/4611686018427387904 1/9223372036854775808 1/18446744073709551616 1/36893488147419103232 1/73786976294838206464 1/147573952589676412928 1/295147905179352825856 1/590295810358705651712 1/1180591620717411303424 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# 2 INCH ROCKET FLARE LAUNCHER SAFETY FIRING GEAR

Plate :



# THE INTERCEPTOR.

PLATE 25

SAFETY SIGNAL LIGHT  
PUSH BUTTON  
MAIN FUSE  
WATER VALVE  
SAFETY SIGNAL LIGHT  
PUSH BUTTON  
MAIN FUSE  
WATER VALVE



## ELEVATION



## SIDE VIEW

SAFETY SIGNAL LIGHT  
PUSH BUTTON  
MAIN FUSE  
WATER VALVE

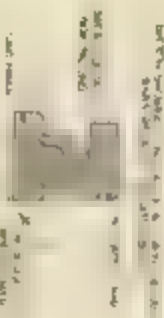


## PLAN

SAFETY SIGNAL LIGHT  
PUSH BUTTON  
MAIN FUSE  
WATER VALVE



## SAFE POSITION



## INTERCEPTOR BREAKING



## DANGER POSITION



## ATTEMPTING TO MAKE





## ELEVATION RECEIVER MECHANICAL POINTER DRIVE

PLATE 26

ELEVATION REG IVZM  
PE - WAFB IN NJ N/ELETS  
Q - 0101E E315W TH 4=MM AB  
PF DO VE IN KAPD THE FD - FVNV  
C MAR-5 IF TTY T Y + U LY S NOVE  
F MCHN = Q A G. / N/ELE  
IN APRIS 3 4 5 6 7 8 9

31 F.ATTN RECOVER  
WE'Y MAJORS IF U' SINGLE

五

2

4

6

44

1

23

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2011年1月1日

VEHICLE ADJUSTMENT FOR  
LOADS UP POWER

SUBJECT INDEX

ELLIVATING

THEY ARE ATTACHED  
TO YOUR LABEL

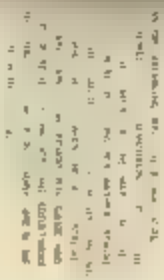
[illegible]

CONFIDENTIAL APPROXIMATE EDITING BY: H.F.2 883 222 47-20

PLAN VIEW

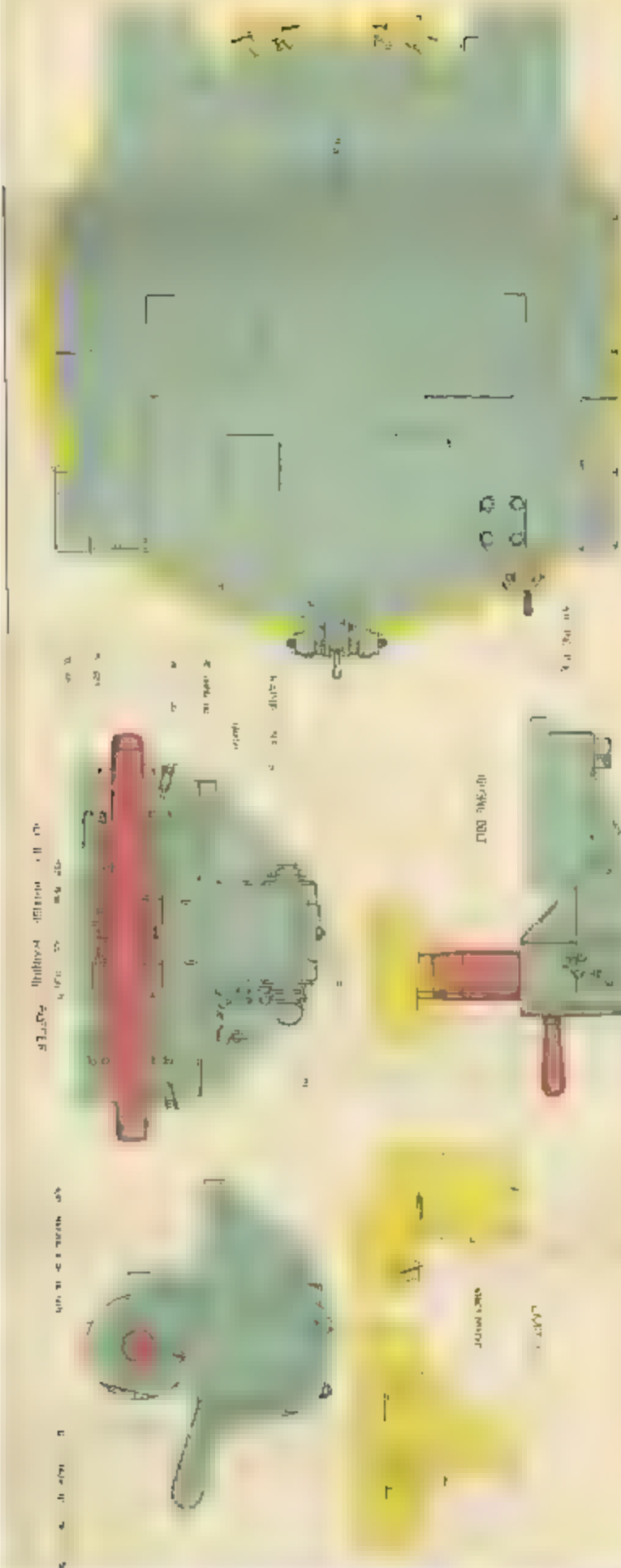
VIEW LOOKING IN DIRECTION OF ARROW



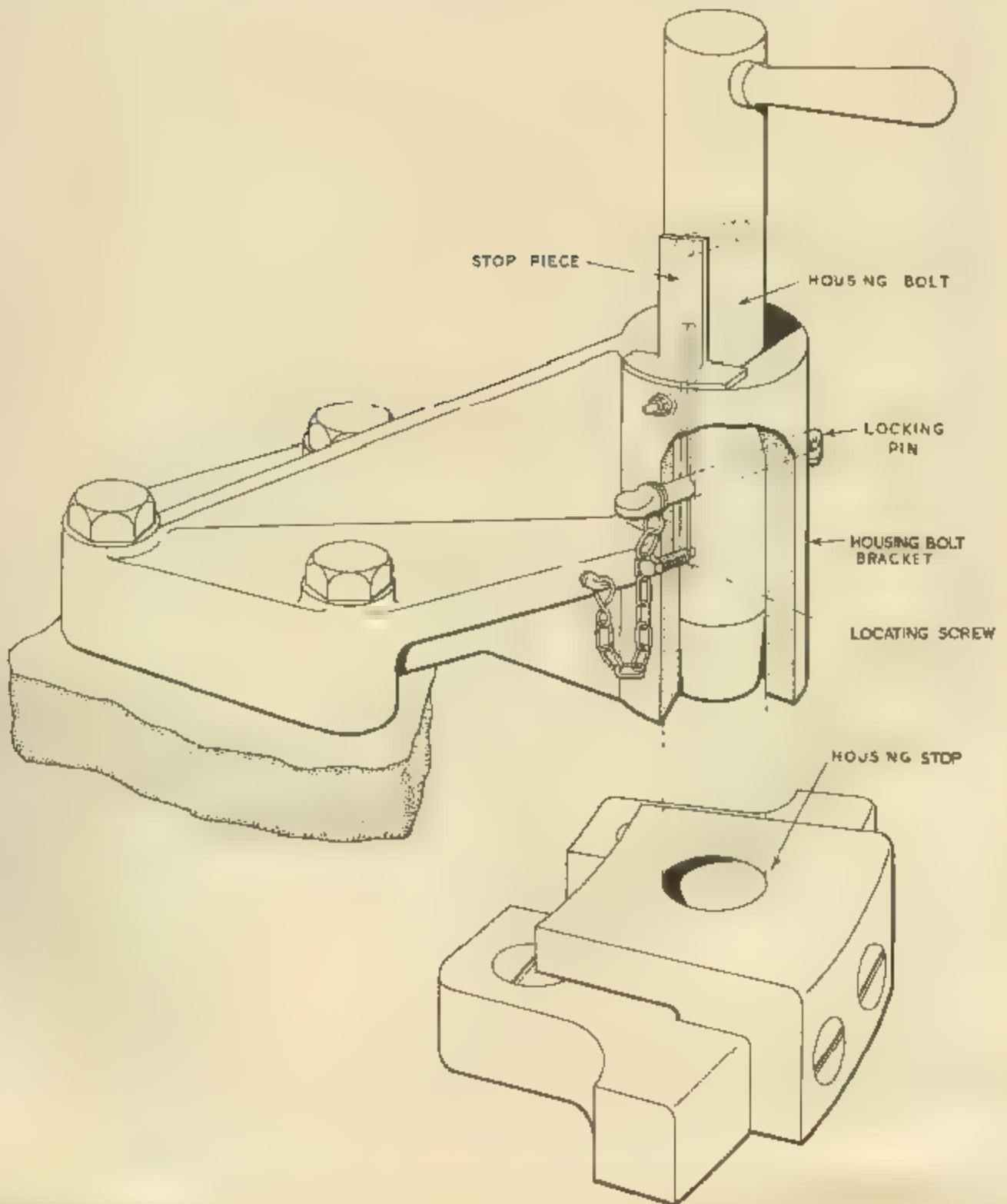




# TRAINING BUFFER, TRAINING LIMIT STOPS AND HOUSING LOCKING BOLT



# TRAINING HOUSING STOP





# TRAINING RECEIVER MECHANICAL POINTER DRIVE. (SHOWN FOR MARK XIX TYPICAL ALSO FOR MARK XX)

PLATE 31

SPRAY SHIELD  
H. LE. R. R. R. R.  
S. L. R. R. R. R.  
R. T. R. R. R. R.  
R. T. R. R. R. R.

SECRET  
REF. AC. 115. 115. 115. 115.  
115. 115. 115. 115.

TRAINING RECEIVER  
H. LE. R. R. R. R.  
S. L. R. R. R. R.  
R. T. R. R. R. R.  
R. T. R. R. R. R.

WATER COUPLES  
ELEVATION

PLAN VIEW

QUADRUPLE THREAD

TRAINING RACK

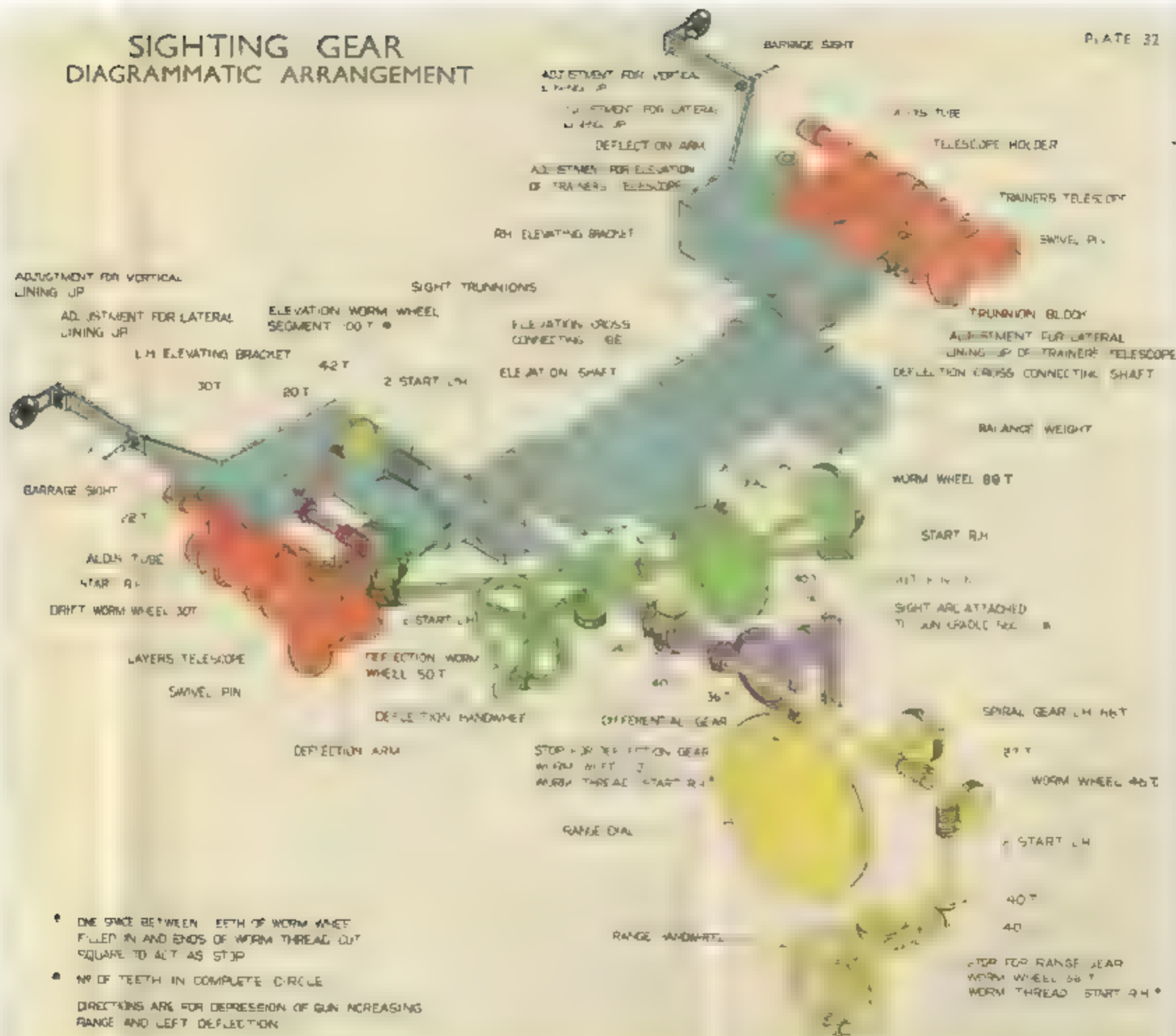
PART ELEVATIONS

TRAINING RECEIVER  
TYPE C MARKS II OR II SINGLE

TRAINING RECEIVER  
TYPE C MARKS II OR II SINGLE

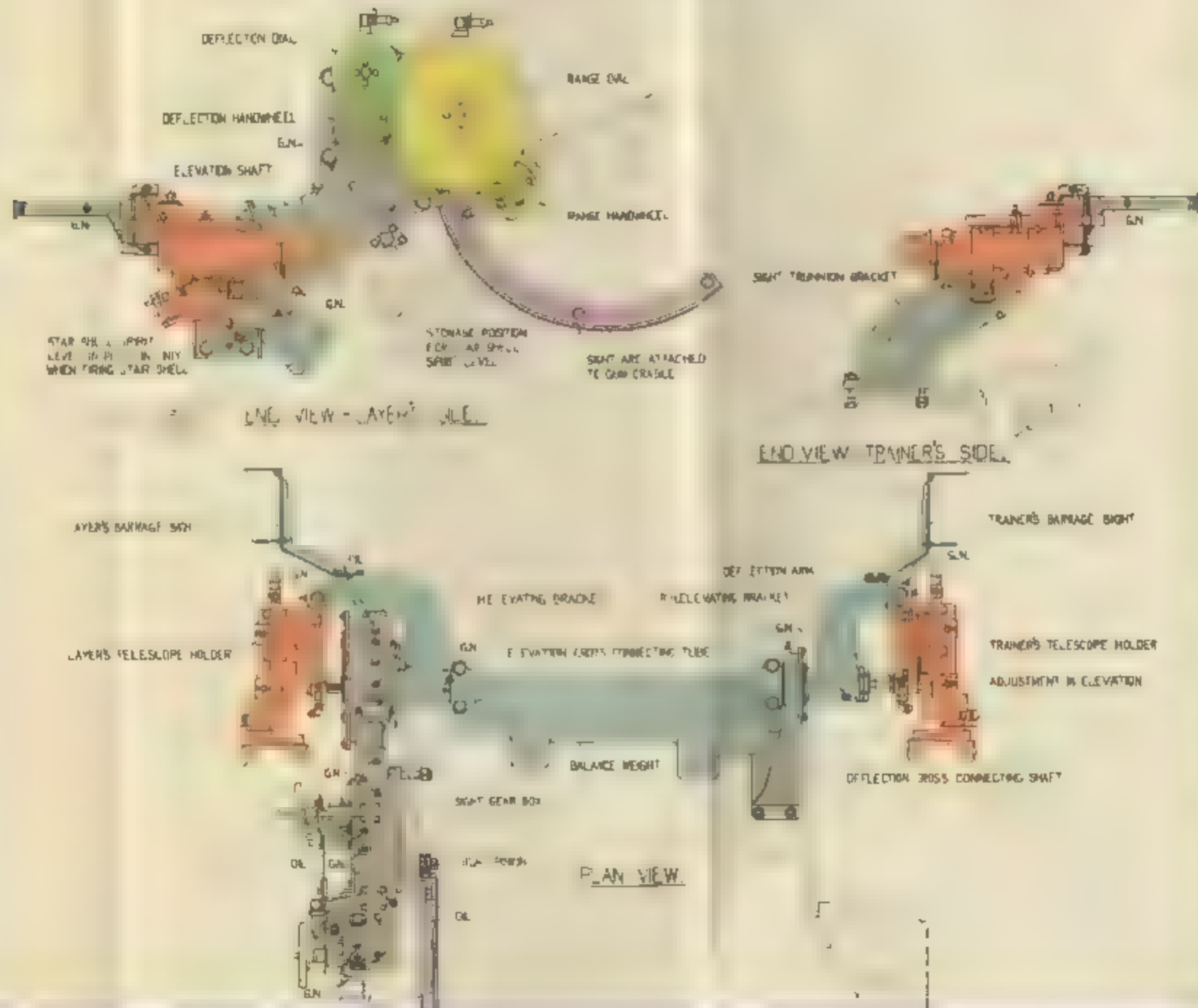
TRAINING RECEIVER  
TYPE C MARKS II OR II SINGLE

## SIGHTING GEAR DIAGRAMMATIC ARRANGEMENT

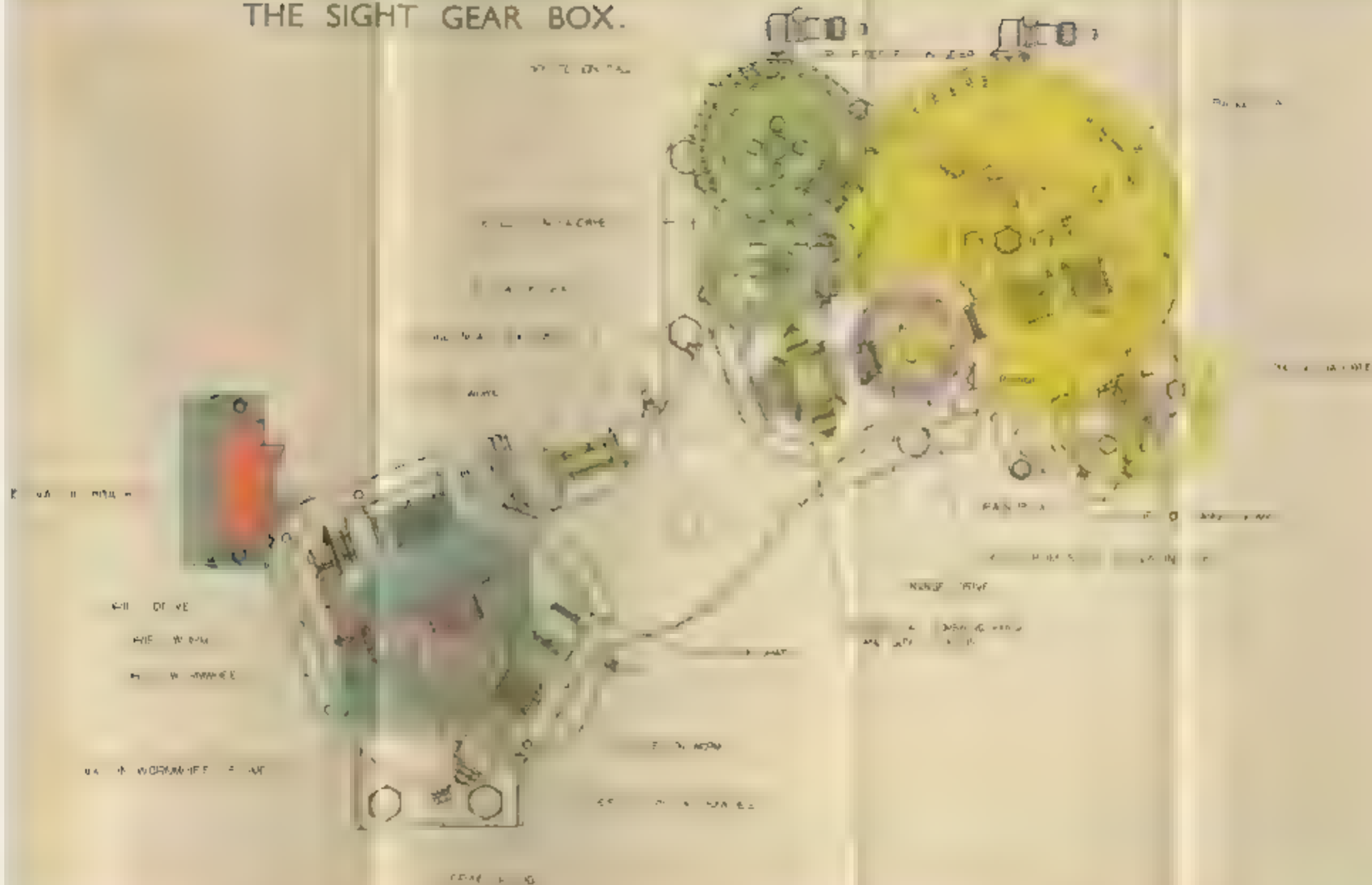


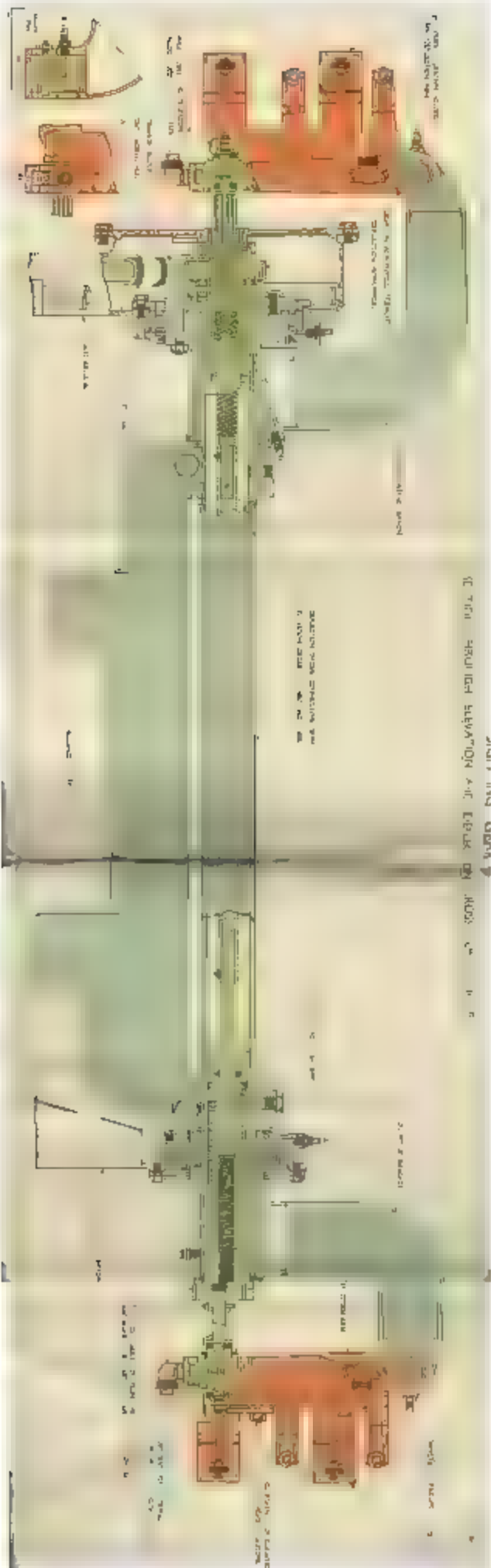
- ONE SPACE BETWEEN EACH OF WORM TEETH FILLED IN AND ENDS OF WORM THREAD CUT SQUARE TO GIVE AS STOP
- NO OF TEETH IN COMPLETE CIRCLE
- DIRECTIONS ARE FOR DEPRESSION OF GUN INCREASING RANGE AND LEFT DEFLECTION

PLATE 33



# SIGHTING GEAR. THE SIGHT GEAR BOX.



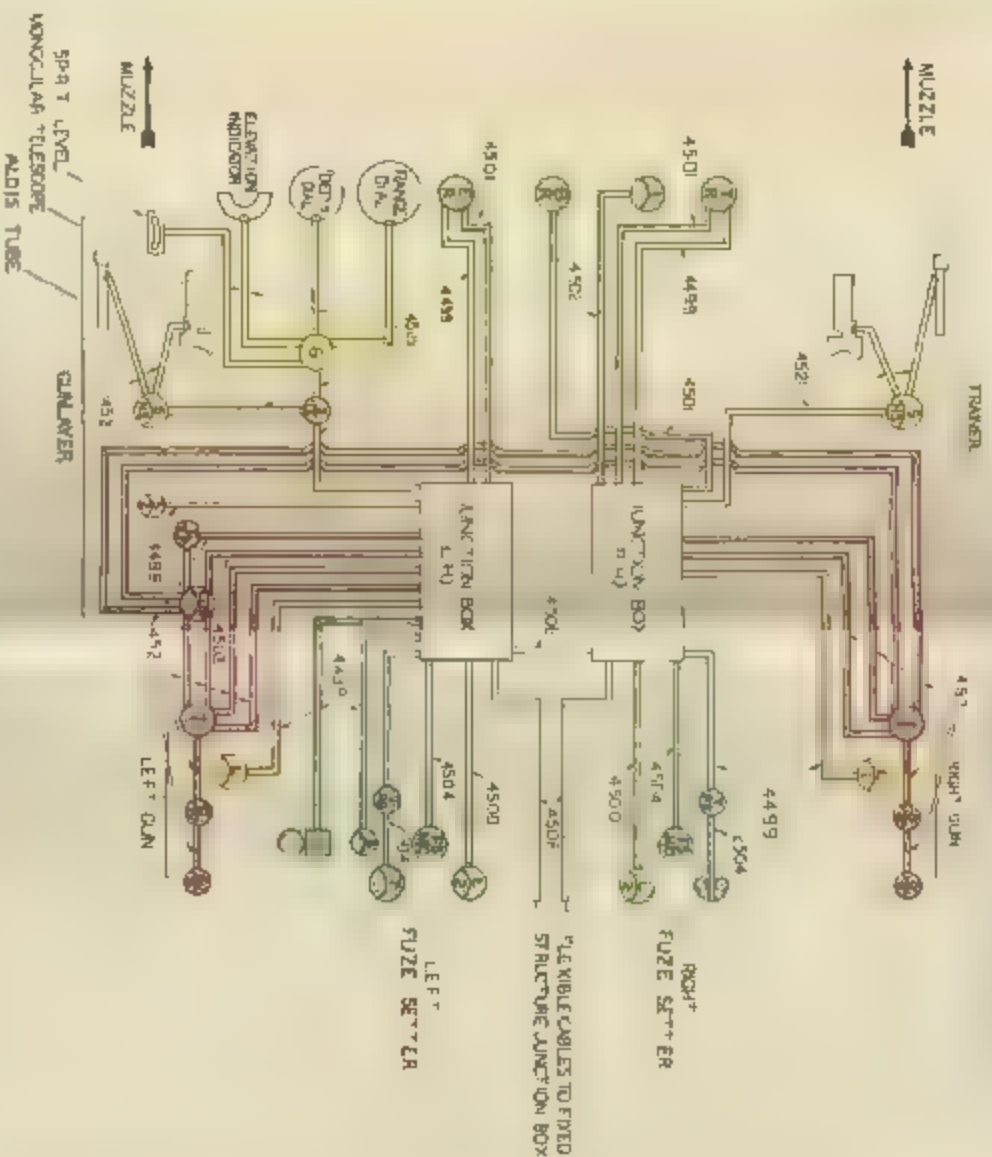


# DIAGRAMMATIC ARRANGEMENT OF CIRCUITS.

PLATE 35

## SINGLE H.A. CONTROL

DRAWN FOR VESSELS WITH W. TYPE TRANSMISSION



## MODIFICATIONS FOR DUPLICATE H.A. CONTROL

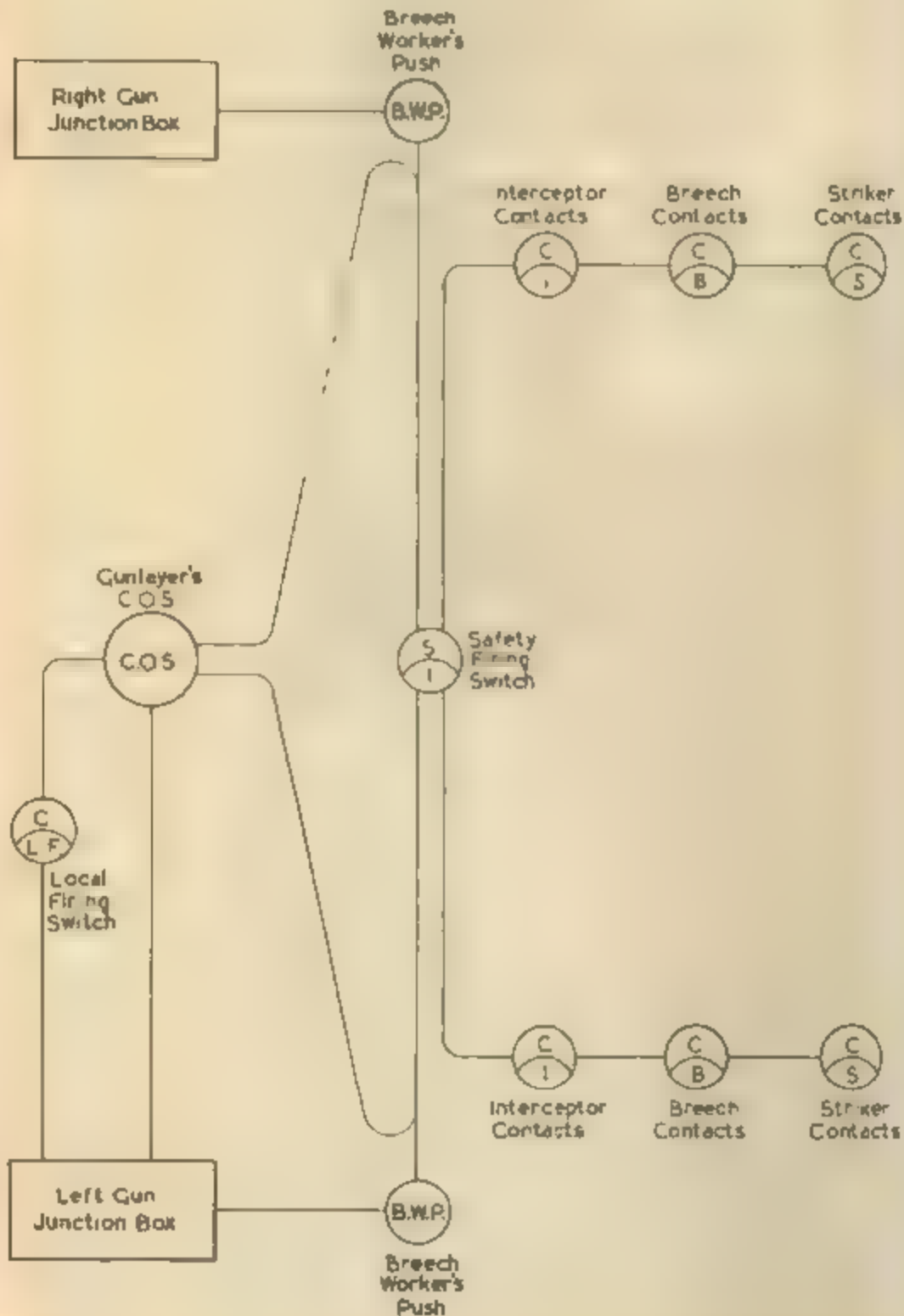
DRAWN FOR VESSELS WITH W. TYPE TRANSMISSION



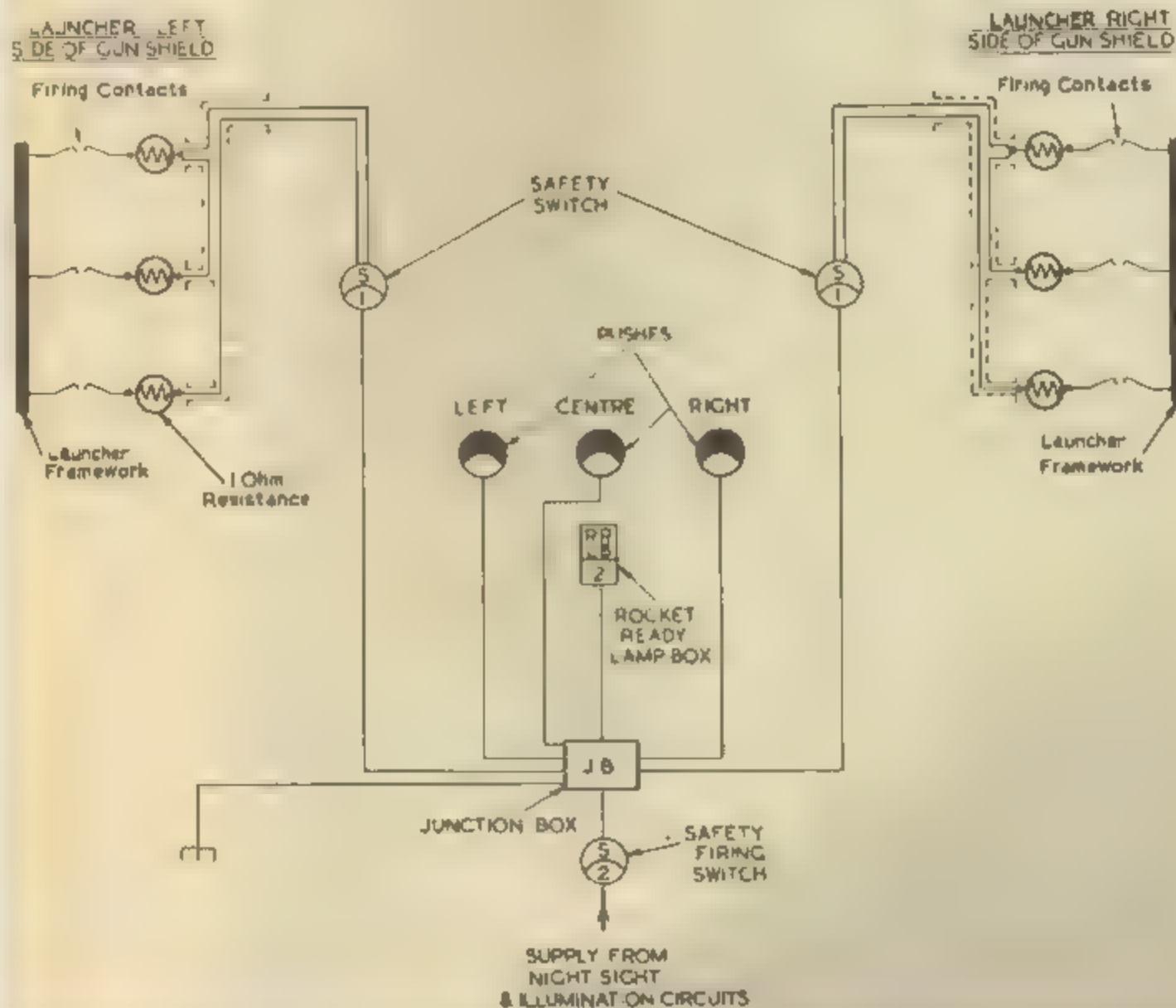
| SYMBOL | DESCRIPTION                  |
|--------|------------------------------|
| 1      | RAISING RETRIBUTIVE TYPE     |
| 2      | ELEVATION INDICATOR TYPE C   |
| 3      | EVEN-ODD BEARING RECEIVER    |
| 4      | OPEN FACED INDICATOR         |
| 5      | RECEIVING DIRECT TO LAMP BOX |
| 6      | BARRAGE INDICATOR LAMP BOX   |
| 7      | JUNCTION BOX OVER SWITCH     |
| 8      | INTERCEPTOR SWITCH           |
| 9      | LOCAL F. B. CONTROL          |
| 10     | BREACH CONTROL               |
| 11     | STRIPPER CONTROL             |
| 12     | 6 WAY CONNECTION BOX         |
| 13     | LOADING LIGHT                |
| 14     | RIGHT SIDE SWITCH            |
| 15     | DIAL LAMP SWITCH             |
| 16     | 5 P. SWITCH                  |
| 17     | ELEVATION INDICATOR MARK I   |
| 18     | ELEVATION INDICATOR MARK II  |
| 19     | FUZE SETTING MACHINE         |
| 20     | TELEPHONE RING BOX           |
| 21     | BUZZER                       |
| 22     | BELL CHECK LINE              |



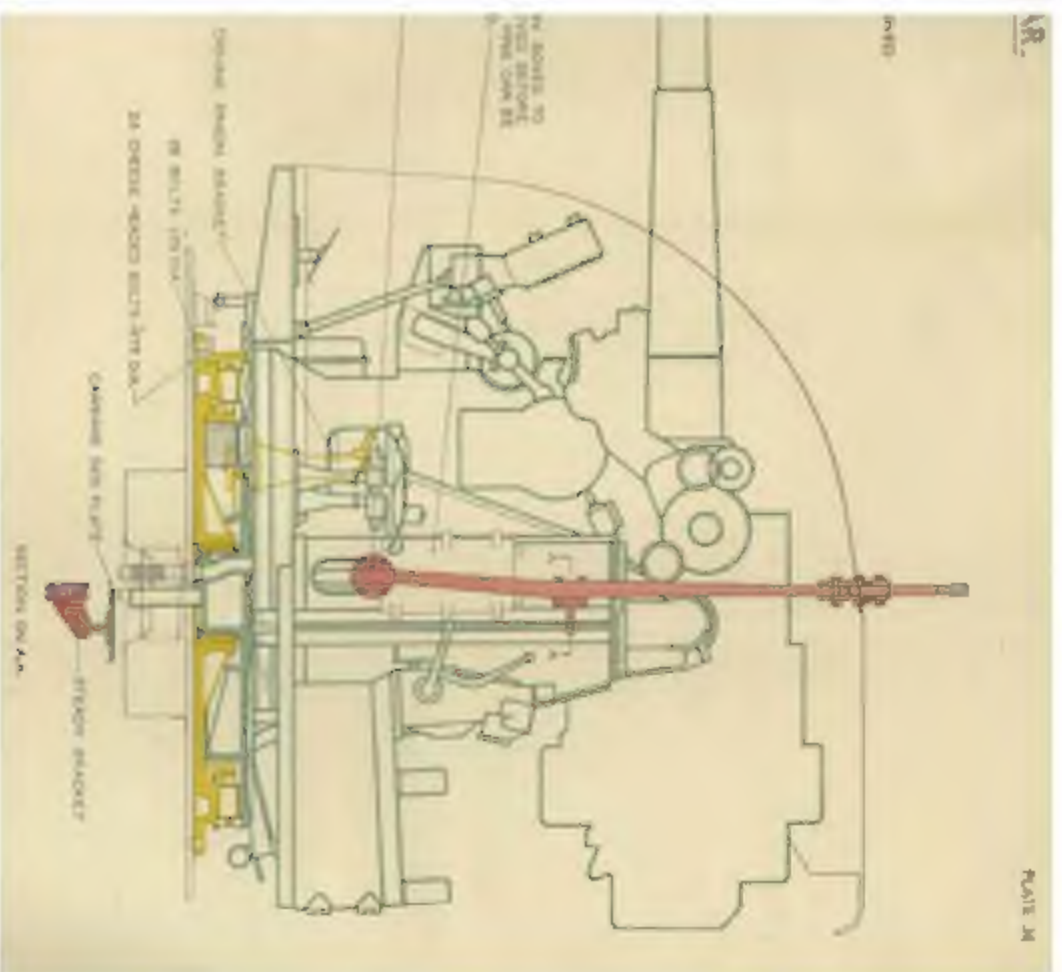
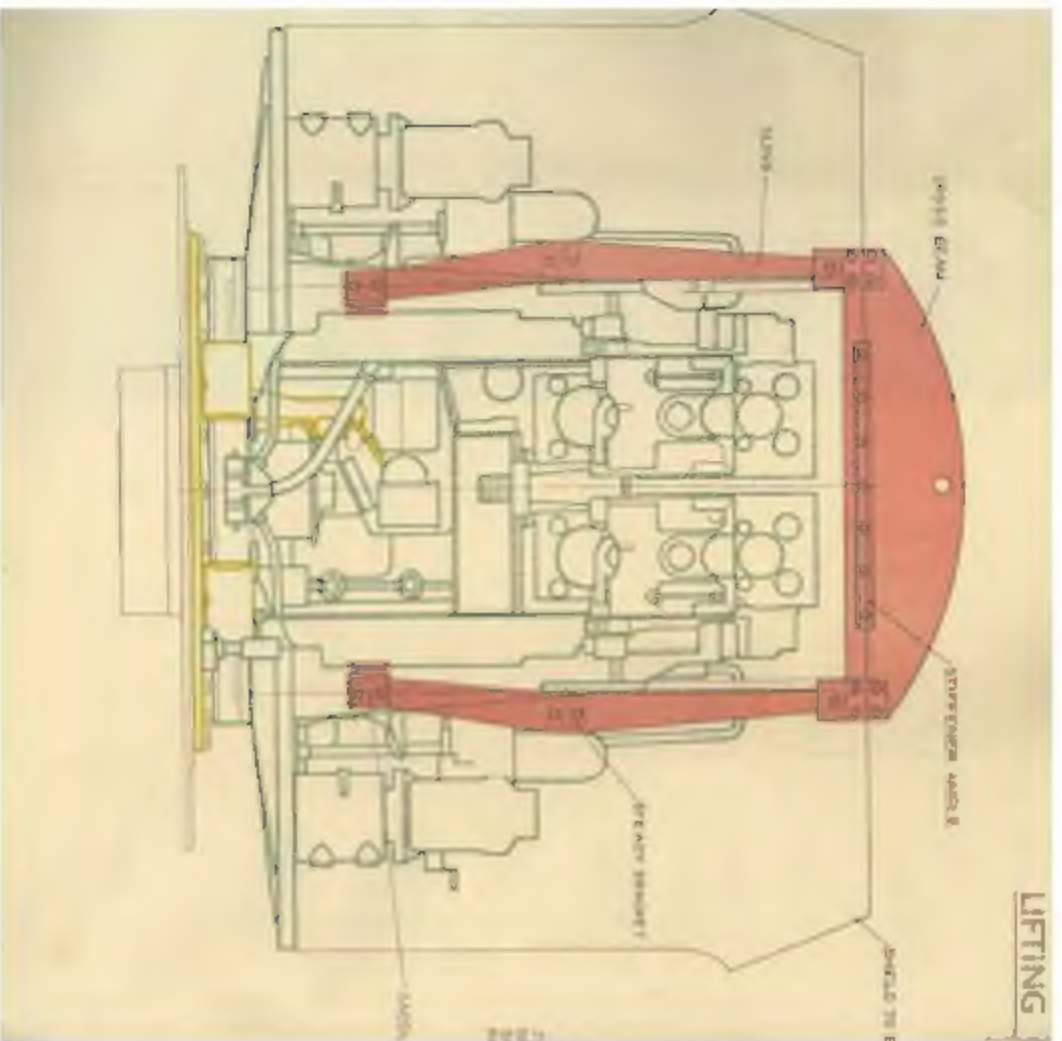
# DIAGRAM MAT C ARRANGEMENT OF FIRING CIRCUITS (when SAFETY FIRING SWITCH is fitted)



# 2 NCH ROCKET FLARE LAUNCHER WIRING DIAGRAM

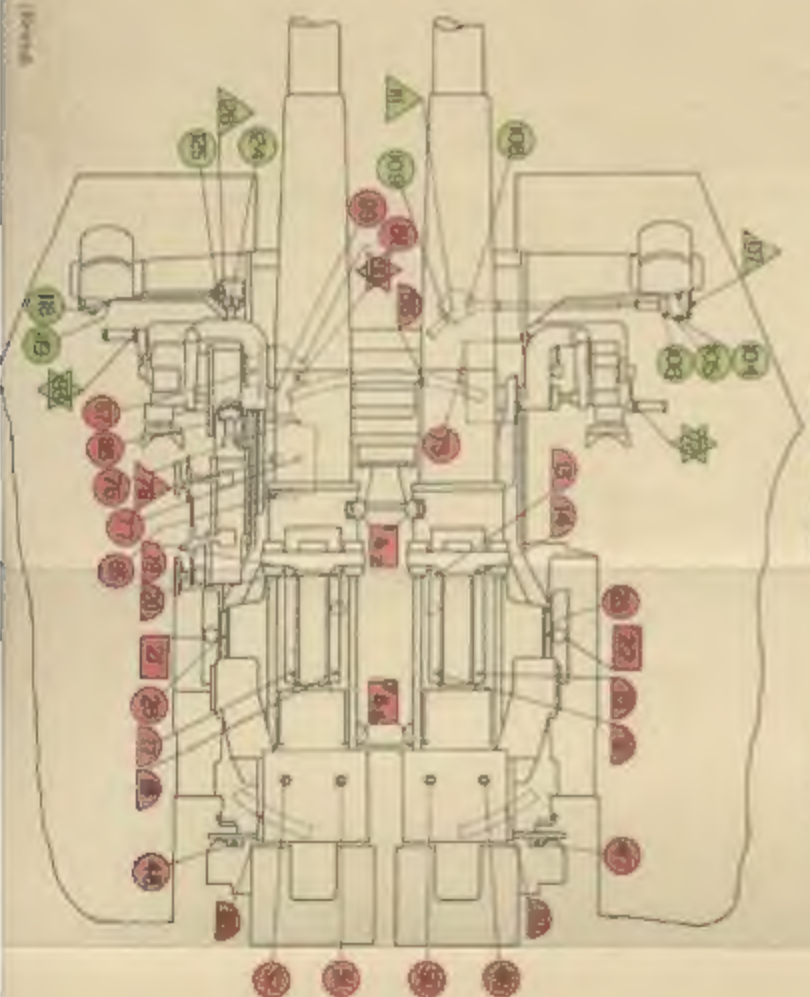
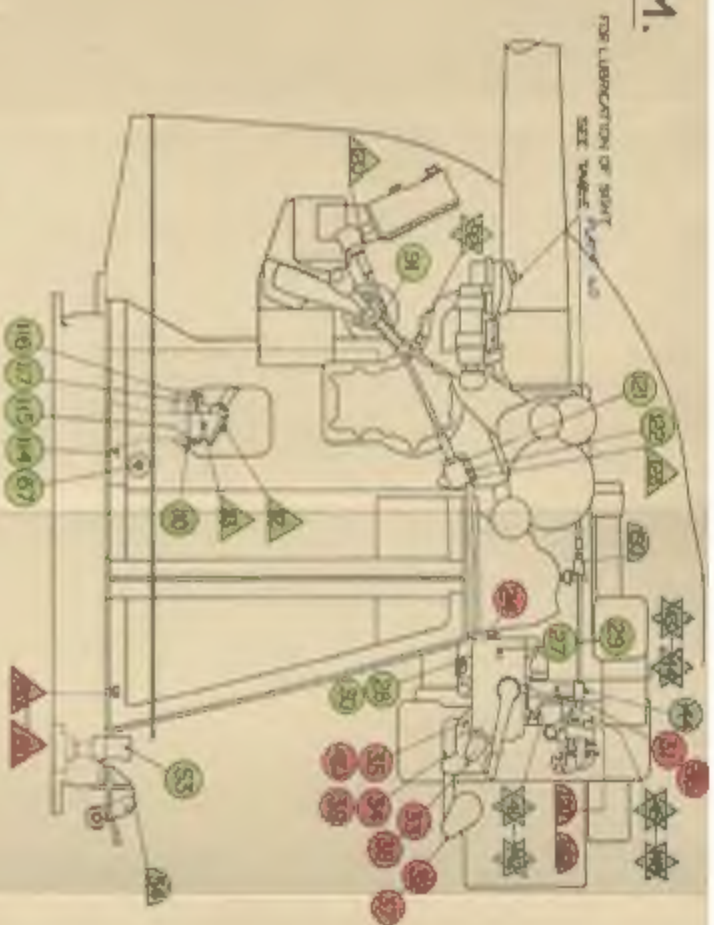








LUBRICATING DIAGRAM.



**SUMMARY**

STAFF FELLOW: LUDWIG KATZ

TUMBLE CLERS

NOTES FOR ASSESSMENT PURPOSES

FOR THE FUTURE LIBRARIANS

SPRINGWELL OIL CUPS

2. HX.ES

39. LUBRICATORS

THE UNIVERSITY OF CHICAGO PRESS

Effect of social and cultural differences on the use of the Internet

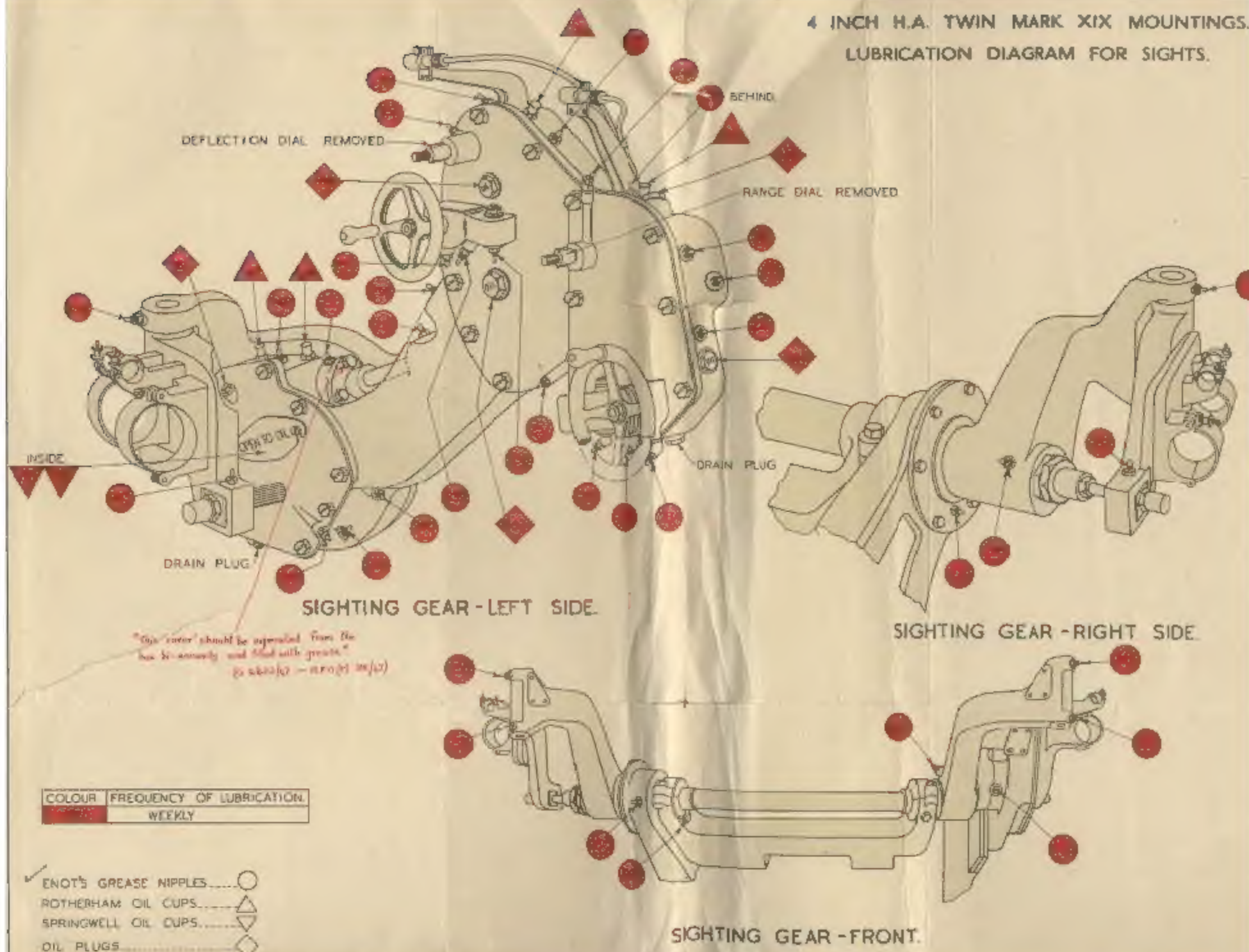
Ward 147th 147th

| SELECT COLOR<br>OF SUBSTRATE | FREQUENCY OF<br>LIBRICATION |
|------------------------------|-----------------------------|
| RED                          | WEEKLY                      |
| GREEN                        | MONTHLY                     |
| BLUE                         | MONTHLY                     |

PLATE 39

# 4 INCH H.A. TWIN MARK XIX MOUNTINGS.

## LUBRICATION DIAGRAM FOR SIGHTS.



"This cover should be removed from the box bi-annually and filled with grease."  
 (5 1/2 lbs) - (17 1/2) (10/12)

| COLOUR | FREQUENCY OF LUBRICATION. |
|--------|---------------------------|
| Red    | WEEKLY                    |

- ✓ ENOT'S GREASE NIPPLES.....○
- ROTHERHAM OIL CUPS.....△
- SPRINGWELL OIL CUPS.....◇
- OIL PLUGS.....◇